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LYMPHANGIOPLASTY: HANDLEY'S METHOD.*

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IN the *Lancet* of March 14, 1908, W. Sampson Handley¹ published a preliminary note on "A New Method for the Relief of the Brawny Arm of Breast Cancer and for Similar Conditions of Lymphatic Œdema."

The term "lymphangioplasty" was proposed by Handley for a method of producing new channels for the flow of lymph, in other words, new or artificial lymph-ducts. Handley has accomplished this to his satisfaction by the introduction into the subcutaneous tissues of strands of tubular silk.

When Handley proposed this method he was doubtless not aware that Lambotte² had used the same principle in an attempt to drain the abdominal cavity in a case of ascites. Of this I shall speak in its proper place.

Handley states that brawny arm occurs in 16 per cent. of cases of breast cancer. He believes the pathology of this condition is to be found only in accepting his theory as to the permeation of cancer. If his conception of the condition be true, then brawny arm exists only in cases where cancer is present and is progressive. I am not prepared to agree with Handley in his idea of the pathology and pathogenesis of this condition. I have had cases in which brawny arm has

* Read before the New York Surgical Society, February 12, 1913.

occurred after the radical operation for cancer and in which there were no other evidences of the recurrence or the continuance of the original disease.

Be that as it may, it is not my purpose in this paper to enter into a discussion of the etiology of brawny arm and like conditions, but rather to confine myself to the consideration of the operative procedure which Handley has proposed, and to place before the profession data which will serve to determine whether the operation has proved successful or not.

To do this I have made a search of the literature since Handley's original proposition, with the idea of collecting all reported cases and classifying them as to the conditions for which the operation was employed, and tabulating the results obtained by Handley himself and by other operators. In going over the literature I find that the operation has been employed for the following conditions: brawny arm the result of breast cancer; elephantiasis; chronic œdema of the leg; chronic or hard œdema of the face and eyelids following erysipelas; and ascites due to cirrhosis of the liver. I have purposely omitted from this review cases of hydrocephalus and serous meningitis, as well as one or two other conditions for which the operation has been suggested, feeling that the examples I have taken are sufficient for our purpose.

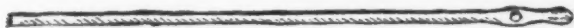
I find that the operation has been performed in 20 reported cases of brawny arm; in 17 cases of elephantiasis; in 3 cases of chronic œdema of the leg; in 3 cases of solid œdema of the face and eyelids; and in 10 cases of ascites. This does not include a number of cases reported as having been operated upon, but in which no details are given.

The above is the result of a careful study of the literature for reported cases. While it is not claimed to be complete, it certainly covers most of the cases thus far recorded.

I was so much impressed with the possibilities of this operation that I have employed it in two cases, one of brawny arm following cancer of the breast, and one of ascites due to cirrhosis of the liver.

The case of brawny arm has already been recorded, having been exhibited before the New York Surgical Society on January 8, 1913.³ In that particular case there was no other evidence whatever of recurrence or continuance of carcinoma. The swelling came on about a year after the operation for removal of the breast, which was performed three years ago. The patient is in perfect health and vigor, she has perfect use of the arm and hand, and is free from pain. I performed Handley's operation for the swelling of her arm on March 23, 1912, more than two years after the first operation. As far as I can estimate, the result of this lymphangioplasty was a failure. There is no pain now, but there was no pain before this operation. There has been no diminution in the size of the arm. I performed the lymphangioplasty after the method of Handley, except that I used a single loop of silk at the anterior and at the posterior aspect of the limb instead of a double one as advised by Handley. I have not had the woman keep her arm in an elevated position as advised by Handley.

FIG. 1.



Syms's probe for lymphangioplasty.

For the purpose of this operation I devised a special probe which was exhibited at the New York Surgical Society on January 8, 1913 (Fig. 1). It has a bulb and an eye at the same end. This is a great advantage when it comes to that part of the operation in which we desire to unthread the silk.

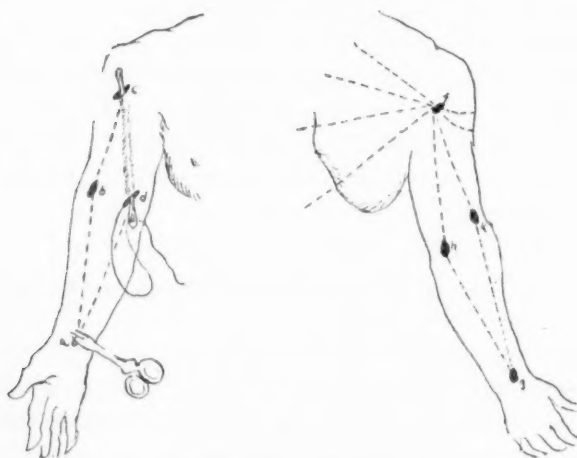
My second case was one of ascites due to cirrhosis of the liver. In this case I did an omentopexy after the manner of Narath, and I also employed lymphangioplasty as described by Handley. Immediately after the operation the abdomen refilled, but it soon began to subside and a few days after the operation there was no evidence of fluid within the abdomen. There was swelling in the region of the thighs where the threads terminated, the lower wound had partly separated, and some drainage along the silk threads could be seen. There was also evidently some drainage in the subcutaneous pocket where the omentum was placed. My impression is that this case was being satisfactorily drained and I had hoped to be able to report a good result, for the progress was encouraging. Unfortunately the patient went into a sudden

collapse 15 days after the operation and died. The patient's untimely death and the fact that there was no autopsy obtained unfortunately make the case of little value as a clinical report.

Brawny Arm.—Inasmuch as it was for brawny arm that Handley first proposed this operation, I shall proceed at once to a consideration of this phase of our subject.

I feel that I cannot make a better introduction than by quoting Handley's own description of the method of operating:

FIG. 2.



Handley's lymphangioplasty. (Binnie).

"The tissues of the arm are drained by two long U-shaped lines of silk, each line composed of two threads of No. 12 tubular silk. One of these lines drains the front of the arm, the other the back. The bend of each U lies immediately above the wrist, and its two limbs occupy respectively the radial and ulnar sides of the limb. Thus, along the whole length of the limb, are found four double lines of silk, spaced out around the limb as nearly as possible at quadrant intervals. Toward the shoulder the lines of silk on the flexor aspect curve outward around the deltoid muscles, and converge to meet the ascending threads from the posterior aspect at a point near the posterior border of the deltoid. From this point the silk threads again radiate in the subcutaneous tissue of the back, terminating by free ends in the subcutaneous tissues of the scapular region. It is perhaps still better to lead some of them to the scapular region of the opposite side, and others to the lumbar region of the same side, if there is any sign of the œdema extending from the arm to the trunk.

"The operation is done as follows (Fig. 2): Take a double line of silk rather more than twice as long as the arm, and mark its mid-point by clipping on it a pair of artery forceps. Wrap up one-half its length in gauze. Thread the two free ends of the other half through the eye of a long probe. Make an incision one-half inch long through the skin at the middle of the front of the forearm, just above the wrist-joint. Thrust the probe in the desired line upward in the subcutaneous tissues well away from the skin toward the region of the elbow, as high as is convenient, and cut down upon its point. Withdraw the probe through the incision last made, and draw the silk after it as far as it will come. Introduce the probe through the incision from which it has just emerged, thrust it upward again in the selected line, and repeat the foregoing steps until the point selected for the convergence of the threads is reached. Here an incision one inch long is made, through which the probe with its two silk threads is drawn out. The other half of the silk loop is now led upward in the selected line along the other border of the flexor surface. The limb is turned over and the extensor loop of silk is similarly introduced. When this has been done eight free ends of silk are hanging out from the incision of convergence at the posterior border of the deltoid. Two at a time these are tucked away in various directions in the subcutaneous tissues of the back by the following manœuvre:

"Clip a forceps on the selected pair of silk threads just where it emerges from the topmost incision. Take a long probe, cut off the ends of the two threads so that they are four inches shorter than the probe, and thread them into the eye. Thrust the probe downward from the incision in the desired direction until the probe unthreads itself. Withdraw the probe carefully, leaving the two silk threads to occupy its track. When all the threads have thus been tucked away the operation is completed by sewing up the incisions with horsehair."

It was found that lymphangioplasty has been performed for brawny arm in 20 recorded cases. Of these, 9 cases were reported as successful, 9 as failures, and in 2 cases there was no report as to whether the swelling had subsided or not. These 20 operations were performed as follows: 15 times by Handley;⁴ twice by Gamgee;⁵ once by Clarke;⁶ once by Goebel;⁷ once by Syms.³

Handley had some success in 8 cases and failures in 7. Gamgee reported 2 cases in which he claimed improvement as to pain, but in which he made no record as to whether or not there was a reduction in the amount of swelling. Clarke claimed success in his case, stating that the swelling was reduced. He did not, however, give comparative measurements. Goebel's case was a failure, and, as previously stated, my own was a failure.

It is to be noted that Handley states that the patients after operation must keep the arm on an elevated plane for several hours during the day, and that otherwise the swelling is liable to recur. Handley's cases have been reported in detail and some of his results are very gratifying, but in none of his cases did the arm return to its natural size, though there was great reduction in the swelling. And it must not be forgotten that he insists upon elevation of the limb during several hours of each day as a part of the routine after-treatment. Of course gravitation exerts a very determining influence in such conditions of swelling.

Elephantiasis.—Let us now consider elephantiasis. Lymphangioplasty has been performed for this condition by Handley⁸ in 2 cases; by Deaudt⁹ in 2 cases; by Lexer¹⁰ in 2 cases; by Goebel⁷ in 1 case; by Lanieris¹¹ in 2 cases; and by Madden, Ibrahim and Ferguson¹² in 8 cases.

The results in these 17 cases may be said to represent 17 failures. There was no case of cure. In practically all of the cases there was no improvement whatever. In one of Lexer's cases there was claimed to be partial success.

The most noteworthy contribution to the subject of lymphangioplasty in the treatment of elephantiasis is that of Madden, Ibrahim and Ferguson. These authors state that their clinical results are entirely in accord with the statements of Handley to the effect that lymphangioplasty has failed to establish its position in the treatment of elephantiasis. Their findings, however, in and around threads taken from the limbs two or three weeks after lymphangioplasty, and in others experimentally introduced into the subcutaneous tissue of guinea pigs, appear to show that failure is not due only to the action of gravity to which Handley refers but also to the fact that the artificial lymph channels will not persist for any length of time. There is finally an obstruction to the lymph return from obliteration of the lymphatics in the neighborhood of the inserted thread. Handley's technic was carefully followed in all of their cases.

The authors conducted three series of observations in order to determine the fate of the silk threads buried in the tissues.

The first series concerned the conditions after lymphangioplasty in a healthy patient. The second concerned the condition of the thread and surrounding tissues after lymphangioplasty for elephantiasis; the third concerned experimental lymphangioplasty in healthy guinea pigs.

The conclusions, drawn from their clinical observations and from their experimental investigations, are so interesting and important that I feel they should be quoted in full:

"1. Clinically, it is abundantly evident that lymphangioplasty fails to effect anything but a very temporary improvement in elephantiasis of the legs. The swelling is very markedly reduced within 48 hours after the operation; but the improvement persists only so long as the recumbent position is maintained. Within at most 21 days after the operation, or as soon as the patient begins to walk, the swelling invariably returns and no permanent improvement results.

"2. The examination of the tissues surrounding the threads introduced during the operation of lymphangioplasty in cases of elephantiasis, and also around threads introduced into healthy tissues of man and of guinea pigs, supplies very adequate reasons for the failure of the operation.

"Important as the action of gravity may be in contributing to the failure to maintain a new and artificial lymphatic circulation, it appears that this want of success is due in far greater degree to definite reactive changes in the tissues immediately around the thread, which soon isolate the new lymph tube from the surrounding lymphatic areas and eventually completely obliterate it.

"Briefly the series of changes in the tissues around the buried longitudinal threads in the subcutaneous tissues are as follows:

"1. For a short time the threads, by virtue of their capillary action, drain the surrounding tissues of the lymph contained in them.

"2. The threads in the tissues soon excite a definite cellular reaction, which leads comparatively soon—from 14 to 21 days—to the formation of a dense and progressively contracting fibrous tissue. This walls off the thread and crushes the ad-

jacent lymphatics out of existence, and thus effectually prevents any absorption of fluid into the space immediately around the thread itself. These fibrous changes, occurring around the ends of the thread, as well as along its whole length, eventually completely isolate it, and it may then perhaps be compared to a long worm lying within an impermeable sheath.

"3. The thread is later penetrated by rows of cells, running in along its fibrils, which must eventually lead to its complete disintegration; and the formation of a solid column of dense fibrous tissue along which no absorption of fluid of any kind can possibly occur."

Chronic Œdema of the Leg.—Lymphangioplasty has been performed in three recorded cases of chronic œdema of the leg. Clarke⁶ reported two cases, with improvement, and Haslam¹³ reported one case as cured.

Chronic Œdema of the Face and Eyelids.—Three cases have been reported in which lymphangioplasty has been performed in this condition, two by Mitchell,¹⁴ and one by Taylor.¹⁵ In each of these cases a permanent cure resulted.

Ascites.—As far as I know Lambotte² is entitled to the credit of originating the idea of attempting to drain the abdomen by means of silk threads. He reported his case in 1905, three years before Handley's first article on the subject.

Silk thread drainage has been employed in the treatment of ascites by several surgeons. Of the available recorded cases, ten may be specially considered. (Paterson¹⁶ mentions the fact that he employed this method unsuccessfully in several cases.) Lambotte² employed this method in 1 case, without success. Handley^{8,17} performed the operation 5 times, twice successfully and 3 times unsuccessfully. Stoney and Moorhead¹⁸ report 1 case, with success. Villard and Tavernier¹⁹ employed lymphangioplasty in conjunction with Ruotte's operation in 1 case, with partial success. Rosenberger²⁰ combined lymphangioplasty with Talma's operation in 1 case, with success. My own case as stated is of little value as a clinical report though it did show something as to early drainage.

For a description of the technic to be followed when employing lymphangioplasty for the drainage of ascites, I again quote Handley's own words:

The abdomen was opened in the left semilunar line; "a stout needle threaded double with lymphangioplasty silk was now passed in and out in a series of loops through the peritoneal cavity, whence they could suck up fluid by capillary attraction. The process was repeated with two other threads. The four threads were conducted in the manner described to a point close to the anterior superior spine. With the aid of a long probe they were then thrust beneath the outer end of Poupart's ligament some way downward into the subcutaneous tissues of the thigh. The abdominal wound was now closed in such a way that the sutures used proved additional permanent channels for the escape of fluid from the peritoneal cavity. A number of thick silk ligatures were employed, taking up the peritoneum and the muscular layers of the abdomen but leaving out the skin. These were tied and the skin was then closed over them with a continuous superficial suture."

The study of the above cases of ascites treated by means of silk thread drainage shows thus far that of the ten cases in which it was employed successes and partial successes or failures are about evenly divided. In two of the more or less successful cases lymphangioplasty was used in conjunction with other operative procedures. In the fifth edition of Binnie's²¹ work on Operative Surgery will be found an excellent treatise on this subject.

In summing up our findings of reported cases of the application of lymphangioplasty in various conditions, we see that the results have been as follows:

Brawny arm, 20 cases, with 9 successes and 9 failures, and 2 cases with no report as to swelling.

Elephantiasis, 17 cases, with practically 17 failures.

Chronic œdema of the leg (not elephantiasis), 3 cases, with 3 successes.

Chronic œdema of the face and eyelids, 3 cases, with 3 successes.

Ascites, 10 cases with success in 5 and with partial success or failure in 5.

In considering the results in brawny arm and in studying the reports of cases, we must give due consideration to the

more or less indefiniteness of the condition. I have classed as successes those cases in which there was marked diminution in the swelling and in which there was satisfactory relief of pain and disability. I do not believe that the operation has been a complete success in any of the cases thus far reported, nor do I believe that it has been claimed that the operation produces a restoration amounting to the normal condition. However, I think it is fair to concede that the operation has been a success in any case in which it has produced a marked reduction of the swelling with a consequent improvement in the subjective symptoms.

The scientific investigation made by Ibrahim, Madden and Ferguson is of the utmost importance. It would seemingly demonstrate the fact that the method may be useless; certainly it has proven so in cases of elephantiasis. My own feeling is that the operation is a very ingenious one, and is well worthy of further trial. In a limited number of cases it has met with success in the treatment of chronic œdema of the face and of the leg (not due to elephantiasis). I must confess that I feel sceptical as to its success when employed for the relief of brawny arm, though I shall certainly give it a further test. I have a feeling that we may find its greatest usefulness in cases of ascites due to cirrhosis of the liver. In cases of ascites I believe lymphangioplasty should be combined with the best form of omentopexy. In my opinion Narath's method of omentopexy is the best one which has yet been proposed. It may be that these patients can be relieved by the establishment of a collateral circulation through the omentum. On the other hand, the explanation of the relief which has been obtained may be found in Binnie's ²¹ suggestion that in the performance of omentopexy there has been established some incidental process of internal drainage. In the case reported by me I believe there was a drainage of the ascitic fluid to the subcutaneous tissues along the line of the omentopexy.

If the above report may act as an aid to the profession in throwing light on this interesting subject, I shall feel well paid for my humble efforts in that direction.

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INTERSCAPULOTHORACIC AMPUTATION OF THE SHOULDER.*

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FROM my experience I should say this is an operation called for far more frequently than it is performed, if we judge from the number of cases reported. In my practice I have advised the procedure in many cases where I thought it justifiable, but all, except the two reported below, have refused to submit to the operation. No doubt many cases that have been operated upon have not been published, still this would not account for the few recorded, when we consider the frequency of the conditions demanding such an operation. These conditions are, first, traumatisms of the shoulder, including gun-shot wounds. While the mortality in these cases is necessarily high (25 per cent.) from shock, hemorrhage and infection, I have no doubt that in the future, with the aid of intratracheal insufflation, nerve block, transfusions, etc., this mortality will be much reduced. Second, cases of extreme bone disease of the shoulder and upper arm. Third, all cases of sarcoma of the arm and shoulder, except possibly those of giant-celled sarcoma limited to the lower two-thirds of the humerus. Fourth, all cases of carcinoma involving the upper half of the arm, and in some cases of carcinoma of the breast, where the axilla and arm are involved. Fifth, some cases of tuberculous disease.

While there is no doubt that we are indebted to Paul Berger for the first detailed description of the operation, still he was not the first to do it, as Treves¹ gives Ralph Cummings, a surgeon in the English navy, the credit of having done it in 1808, and John Langton, President of the Clinical Society of London, at the meeting of the Society, March 25,

* Read before the St. Louis Surgical Society, Nov. 20, 1912.

1898, stated that Cheselden had performed the operation a century and a half ago. While several others are given the credit of being the first to perform this operation, it would seem that the honor rightly belongs to Cheselden.

This operation is demanded, as stated above, in all cases of sarcoma of the humerus, except the giant-celled variety, limited to the lower two-thirds of the arm, and in no case should the surgeon consent to do an operation for sarcoma of the arm without an immediate complete removal, which can only be accomplished by an interscapular amputation of the shoulder. If there should be any uncertainty as to diagnosis, that must be settled and the operation proceeded with at once. Early operation by the interscapular thoracic method should be insisted upon, so soon as the tumor is recognized, as the literature on sarcoma affords ample evidence of the necessity of prompt and radical action.

The necessity for this immediate radical action is well illustrated by a case, reported by Cobb,² of giant-celled sarcoma of the humerus, of periosteal origin, of only eight weeks' duration. A diagnostic incision being insisted on by the patient showed that the deltoid was infiltrated. Very sharp reaction followed, and eight days later, when the major operation was performed, sarcomatous thrombi were found in the subscapular vein, possibly dislodged at the time of the primary operation.

In Case II reported below, the tumor was removed locally but recurred immediately, and when I first saw the patient four weeks after removal the entire arm was infiltrated to the shoulder, thus necessitating the removal of all the muscles of the arm leading to the thorax.

The necessity of doing the interscapular thoracic amputation in cases of giant-celled sarcomas, involving the upper third of the humerus, was impressed upon me by a case which I had some time ago. The patient was on the table to have this amputation done, when members of the family interfered, and against my better judgment I did a shoulder-joint amputation, and, while there was no local recurrence, the patient

died about two years later from metastasis in the liver, due possibly to the opening of the sources of infection during the operation.

Keen³ thinks it possible that when the disease has invaded the medullary canal that operation may already be too late on account of the physiological fact that the bone marrow has a share, and probably an important one, in the production of the red blood-cells. If this be so it is possible that by this means the blood may be contaminated at the very fountain, and the disease being distributed, metastasis is readily produced, even if the disease has been so thoroughly removed that recurrence *in situ* does not take place.

While the operation is an extensive one and requires much time on account of the careful dissection necessary in order to avoid great loss of blood, thus helping to produce shock, still the mortality is only about 4 per cent. in tumor cases, and 25 per cent. in traumatisms.

According to all authorities the chief danger in this operation is due to hemorrhage, but this can be limited in most cases by tying the axillary artery and vein, a procedure not always easy, but accomplished with comparative ease by resecting the clavicle either in part or as a whole, as recommended by La Conte.⁴ However, I cannot think this latter procedure at all necessary, unless the clavicle itself is involved in the disease. I had no difficulty in either of my cases, although in my second case the patient was a very muscular subject, and the artery and vein very deep seated. I found the difficulties of the operation very much lessened by first dividing the pectoral muscles as close to their origin as possible, from above downward, for the reason that it is very easy to include the artery and vein in the clamps applied to the muscles and which I did in my first case—afterward resecting the middle third of the clavicle either without removing the periosteum or subperiosteally as recommended by Professor Ollier⁵ as a safeguard against wounding the vessels. M. Chevasse says, "that particularly this step is not to be recommended, as the periosteum when left obscures the subclavius muscle, and had to be im-

mediately divided." In my first case I resected the middle third of the clavicle subperiosteally, while in my second case I did not attempt it, and the only difference that I could see in the two methods was that the first method required more time; and I shall not use it in the future. It is certainly not to be considered in cases where the clavicle itself is involved in the disease, as it is likely to favor recurrence. After dividing the pectoral muscles and resecting the clavicle, the subclavius muscle and fascia covering the vessels and nerves should be carefully divided and drawn outward, thus fully exposing the vessels and nerves. The artery should be tied first, and the vein later, after the arm has been emptied of its blood by elevating it until it is blanched. By tying the artery first and emptying the vessels much blood is saved to the circulation, and the danger of wounding the vein and thus causing a troublesome hemorrhage and at the same time allowing the entrance of air into the circulation is diminished, one of the dangers of the operation, and, while not necessarily fatal, is nevertheless to be avoided if possible. In spite of all precautions, however, the loss of blood will sometimes be considerable from a general oozing from the wound surface.

By blocking the nerves and taking other precautions, unnecessary to mention, shock may be prevented in some cases, but not in all, as was demonstrated in my second case. A study of the chart shows the blood-pressure and the pulse to present very little variation until very near the close of the operation, when the pulse went up and the blood-pressure down. This was, no doubt, due to the loss of blood, which, while it did not appear to be very great, must have been more than was apparent, as there was more or less general oozing which it was impossible to control.

Speaking of shock, Cushing⁶ says: "Cocaine injected into a nerve trunk effectually blocks the transmission of all centripetal or sensory impulses. Cocainization, therefore, of main trunks of nerves central to the proposed site of their division in a major amputation prevents the conduction of those impulses resulting from traumatic insult, which other-

wise by acting reflexly through the medullary centres might become the chief factors in the production of shock." He then cites two cases to prove the correctness of the above assertion. In one case the nerves were not cocainized, immediate shock following the division of the nerve trunks, while in the other case in which the nerves were cocainized there was not the least evidence of shock.

According to Cushing,⁶ Crile did this operation without a general anæsthetic by simply blocking off the brachial plexus. Cushing remarks that this method seems utterly impracticable and adds: "This incision must pass through non-anæsthetized territories supplied by cutaneous nerves of thoracic segments. These areas necessarily must be individually cocainized, a difficult performance and one requiring an accurate knowledge of segmental distribution."

In both of my cases the nerves were blocked with 1 per cent. cocaine solution and in neither was there any evidence of shock manifested either by the pulse or by the blood-pressure, both of which were observed with great care when the nerve trunks were divided.

Ether by the intratracheal insufflation method was the anæsthetic used. This I think the method of choice, as it seems to limit shock and diminish very decidedly the post-anæsthetic effects.

In traumatism one of the most frequent causes of death is infection, but this, although it cannot be entirely eliminated in the majority of cases, is not necessarily fatal, as Treves¹ cites a case operated upon by him on the battle-field during the late Boer War, which made an excellent recovery in spite of the fact that it was infected.

In clean cases, infection plays a very unimportant part, as will be seen on a careful consideration of the literature. Barling⁷ reports 19 cases of new growths operated by this method, which he collected, all of which recovered.

It is to be expected that in so extensive a mutilation as the interscapular amputation of the shoulder involves, that the operative mortality would be correspondingly high. Such, however, is not

the case, as the records show in the non-traumatic cases since 1887 a very low mortality—some operators only 2 per cent. This, considering the cachectic condition of many of these patients at the time of operation, is certainly low.

While the immediate results of the operation are favorable, according to Jacobson and Rowlands,³ the ultimate results are less so. "Recurrence, in the case of periosteal sarcomata, takes place, as a rule, within six or twelve months." Treves¹ is of the opinion that, "though interscapulothoracic amputation is probably the best measure in all cases of sarcoma (ossifying or not) of the upper part of the humerus, the prognosis is very gloomy. In at least 75 per cent. fatal recurrence has followed within a year."

On the contrary, Jeanbrau and Riche,² who made a study of the results of this operation, say "that thanks to the collaboration of more than 60 French and foreign surgeons, we have been able to collect the final results of 188 cases. These are so convincing that even the most sceptical must recognize the benefits which accrue, in cases apparently the most desperate, from Berger's operation. Moreover, the results are so much better than in all other operations for tumors, that the opposition of the patient should be overcome so that delay is done away with. It is a fact that patients, frightened at the thought of this mutilation which appears to them altogether out of proportion to the volume of the tumor, of whose malignancy they are ignorant, almost invariably refuse to be operated upon for some time. Experience has taught us that consent is given only after the neoplasm has ruptured the capsule and invaded the muscles.

"Even in the most unfavorable condition which could have been avoided had the opinion of the surgeon influenced the patient into consenting to an early operation, the Berger-Farabeuf operation yields good results and even effects cures that may be considered definite. In nearly every instance the patient is benefited to the extent that justifies the surgical intervention, which, done according to Berger's technic, is really an easy operation, hardly more difficult than a disarticulation of the shoulder.

"Our own researches are such that we are able to establish the following facts in interscapulothoracic amputation for malignant tumor made at the shoulder-joint; that is to say, not preceded by scapulectomy or scapulohumeral disarticulation: First, the mortality which was 29.16 per cent. before 1887 fell to 7.84 per cent. after asepsis and the technic of Berger-Farabeuf were made known. If we had at hand statistics showing what the exact circumstances were in the causation of death, we are convinced that the mortality would fall to 5 per cent. and even below this.

"Second, in taking the average in 105 cases operated upon, we find that the average length of life afterward is 35 months—nearly three years.

We also call attention to the fact that the estimates are the minimum in all cases alive in 1904, or lost to sight.

"Third, this average survival of three years is a result almost un-hoped for when we remember that this mutilation is not agreed to by the patient until the disease is very far advanced, and frequently not until the general condition of the patient is very bad.

"Fourth, cure is possible, as we have traced 24 recoveries living more than five years. In 20 cases we note that patients of Roth, Küster, and Ochsner lived more than ten years, those of Ochsner and Küster more than 13 years, and that of Chavasse 15 years. One patient of M. Berger on whom he operated in 1882 was living in good health in 1898—16 years later. A patient of Syme lived 26 years, after which he was lost sight of.

"The study of these results is encouraging, and seems worthy of making known, because many medical men are sceptical as to the benefit which is conferred on the patient afflicted with sarcoma of the shoulder or the arm and also extending into the soft parts, by the interscapulo-thoracic amputation."

CASE I.—H. R., white, fifty-eight (?), German descent, occupation furniture finisher. Entered the Barnard Free Skin and Cancer Hospital, Sept. 30, 1912, on account of an extensive carcinoma of the upper part of the left arm, the result of an extensive burn, which was sustained 15 years ago with kerosene, over back, arms, and face. Present trouble commenced two years ago, when small lumps were noticed on the inner side of the arm in an area which had been grafted with good results. At present there is a large ulcerated area on the arm extending from a short distance above the elbow to within three inches of the axilla, involving the back and outer side of the arm. This was very offensive, edges indurated, glands in axilla enlarged. Pathologic examination of the base of the ulcer gave a typical picture of epithelioma.

The patient made an uneventful recovery and was out of bed on the fifth day (Fig. 1). The wound healed primarily throughout. At the time of operation he weighed, with arm, 109 pounds, and two weeks after operation he weighed 133 pounds, and had lost his cachectic look.

CASE II.—Male, aged thirty-six years, entered the St. Louis Mullanphy Hospital Nov. 26, 1912, with a very painful tumor of the right arm, on account of which the arm was much enlarged from the shoulder to the hand.

Three years ago while playing ball, he hurt the upper arm throwing ball. He paid little attention to it, as it gave him no

FIG. 1.



Case I.—Six days after operation.



Case II.—Seven days after operation.

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trouble on the day of injury; noticed after that that he could not throw as well as usual. Never had any trouble with arm until three months after injury, when rowing a boat and working arm vigorously noticed it was not as strong as usual. That night a very severe pain came on. Three or four months later was driving nails when arm began to pain him severely again. Arm never felt weak or lost function up to this time. Three months ago, while taking a bath, noticed a hard lump on the fore part of humerus, which was attached to the bone, very hard, but was not painful on pressure. Always after that pained him more or less all the time. Pain worse at night. Hard mass seemed to get cold, and he would have to keep it in hot packs. Pain of dull, aching, heavy character and limited to upper arm entirely. Never noticed any other constitutional symptoms. One month ago to-day had it operated on. Then noticed severe pain first in forearm and later in shoulder. Pain since operation has been gradually growing worse. Never has noticed any symptoms in any way other than these produced by arm. Has not lost any weight; appetite as good as ever; bowels regular; no fever.

The arm was much swollen and infiltrated from the hand to the shoulder-joint, one-half size larger than normal. The induration of the upper arm was hard and elastic, not pitting on pressure. On the outer and posterior surface of the upper arm, commencing just below the upper insertion of the biceps and slightly behind it, was an ulceration about three inches in length and about a half to three-quarters of an inch in width; this was covered with large, unhealthy granulations slightly elevated above the surrounding surface. This was the result of an incision made for the removal of the tumor before the patient entered the hospital.

Pathologic examination of the arm after removal confirmed the diagnosis of small round-celled sarcoma probably arising from the periosteum, invading the soft tissue of the upper arm, without demonstrable axillary glandular involvement.

In both cases the Berger technic was followed, except that the pectoral muscles were divided near their origin and the clavicle resected afterward. In Case I the clavicle was removed subperiosteally, while in Case II this was not done, and it in no way increased the difficulties of the operation.

In all cases of round-celled sarcoma of the arm, the interscapulothoracic amputation of the shoulder should be the operation of choice, as Hasse's⁵ histological demonstrations have proved the tendency to metastasis in the muscles. On that account, all muscles attached to the arm should be removed.

If the patient survive, an artificial shoulder and an artificial arm can be so fitted as to hide the deformity and prevent the feeling of lopsidedness which is almost sure to follow and which is very annoying. Neither of my cases has so far felt any inconvenience from lopsidedness. The second case, when in bed, says he feels all of the time as if he would roll over.

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SOLITARY CYSTS OF THE LIVER.

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SOLITARY cysts of the liver of non-parasitic origin as compared with other conditions found in and about that organ are rare lesions, and there are few cases recorded in the literature on this subject which are identical with the case which I am reporting, as some of the cases reported as solitary cysts have been congenitally dilated gall-bladders or ducts, or cystadenomata, or true cystic livers. They may be either intra- or extrahepatic and vary in size from small shot to large cavities containing several litres of fluid. The right lobe of the liver has been the most frequent site of the cysts in the reported cases and usually the under surface. They have been more common in the female sex, in late middle life. Much discussion has taken place as to the causation of these cysts, but I think the consensus of opinion now is, that they are usually due either to confluence from cystic degeneration or to occlusion of aberrant bile-ducts. Small ones may be caused by degenerative changes in naevi, and larger ones may be due to cystic changes in an adenoma of the bile-ducts. In my case, infarct suggested itself as a possible cause. In a monograph published in 1906 Eli Moschcowitz reviews the literature on non-parasitic cysts of the liver and comes to the following conclusions:

" 1. Non-parasitic cysts of the liver are associated with congenital anomalies in other parts of the body, especially with cysts of the kidney.

" 2. Such cysts of the liver are always associated with congenital anomalies of the liver, consisting in aberrant bile-ducts which may be extra- or intrahepatic.

" 3. These aberrant bile-ducts are embryonal rests formed in the course of development of the liver and have thus far been found only in cystic liver or livers associated with cystic kidney.

"4. Non-parasitic cysts of the liver have their origin in these aberrant ducts, and may assume two forms: one arising from inflammatory hyperplasia of these ducts, the other by retention of fluid in these ducts as the result of congenital obstruction.

"5. There is no valid reason for classifying these cysts as tumors."

They have occurred nevertheless without other anomalies being present. Cases of long standing are usually surrounded by a firm fibrous capsule, which often contains numerous blood-vessels, and calcareous infiltration may be present. The inner surface is smooth and often ridged and of an opaque white color except where it is very thin walled.

The contents vary, but are usually colorless though the fluid may be bile or blood tinged. Albumin is present, and in some cases bile pigment, blood, hæmatoidin, cholesterin, and tyrosin have been found. Microscopically the capsule is composed of laminated fibrous tissue which may contain bile-ducts, sometimes dilated. Occasionally blood pigment is found between the bundles of fibrous tissue. The fibrous tissue invades the liver tissue for a short distance and is lined internally with a layer of epithelial cells, which may be columnar or polyhedral in the small cysts.

In Bland Sutton's case, which he says is one of the few in which an examination of the cyst wall by a competent pathologist was made, the wall where it joined the liver showed small loculi invested with epithelium and many bile-ducts lined with cubical cells, the main cyst wall consisted of fibrous tissue and its inner surface presented spaces covered with flattened epithelium.

In Sharkey's case the capsule of the liver was continuous with both the external and internal surfaces of the cyst wall. Thin septa jutted out from the internal surface and a thick cord ran across the cyst, passing at each end into one of the septa. The walls were made up of fibrous tissue with a single layer of flat epithelial cells on the inner surface. Cyst was found during an autopsy on a woman aged thirty-eight years, who died of a fractured skull.

Corner's case was a woman in late middle life, who for fifteen years had attacks of colicky pain in the right hypochondrium accompanied by vomiting and with radiating pain to the back and right shoulder. The clinical diagnosis was distended gall-bladder. A cyst four inches in diameter was removed unopened. It had been inflamed as shown by the

organized lymph on its surface. The liver substance contiguous to it had also been inflamed and was partly devascularized, hence there was not much hemorrhage attending its removal.

McDonnell's case was in a man aged fifty-eight years, who died of peritonitis from a pyloric ulcer. The cyst occupied the mid upper surface of the liver and measured 9.5 cm. in diameter, and was adherent to the diaphragm and vena cava. The wall was tough, fibrous white on section, and the contents were thick and of an apple green color. Mucin, blood-cells, and hæmin crystals were present. There were no renal cysts.

Cotton and Burgess report a case in a woman of sixty years in which there were no symptoms. It was the size of an egg and in the left lobe. The liver showed signs of cirrhosis.

Müller's case was in a woman aged fifty-nine years, who had observed the tumor for ten years and had had symptoms for five years. It simulated an ovarian cyst and almost filled the abdominal and pelvic cavities. It was attached to the lower and front surface of the liver and contained six litres of chocolate colored fluid.

Shaw and Elting report a case in a female child aged one and a half years in which the right lobe of the liver was occupied by a globular enlargement extending to the level of the umbilicus. Following puncture and evacuation of 900 c.c. of clear fluid the child died, probably of shock. Partial autopsy showed a thick walled cyst apparently originating in the central portion of the right lobe. All external surfaces were smooth and covered with peritoneum. Gall-bladder distinct. Kidneys apparently normal. Cyst wall consisted of dense fibrous tissue without a lining layer of cells. The inner surface in many places was necrotic and contained fibrin, hemorrhage, and granulation tissue.

Plenk's case was in a woman aged forty years, whose death was caused by a perforated gastric ulcer. A cyst the size of a man's head separated the large right lobe of the liver from the small left lobe extending up to the diaphragm. The wall was lined with cylindrical epithelium with some goblet cells, without cilia, under which was a tissue resembling submucosa, with blood-vessels. Signs of inflammation on the inner surface were probably due to infection from the gastric ulcer by its adhesions. Plenk thought his case to be a cyst of the bile-ducts, which through pressure on the surrounding liver caused atrophy of the left lobe and hypertrophy of the right lobe of the liver.

Hoffman's case was in a woman aged twenty-eight years, who had an enlargement of the abdomen and some pain, no jaundice, no fluctuation. On operation a cyst the size of a man's head occupying the quadrate lobe was found and enucleated. The wall consisted of three layers of connective tissue without epithelial lining; containing rests of liver parenchyma. Hoffman believed his case to be a cystadenoma of the bile-ducts.

Reynold's case was in a woman aged fifty years, movable tumor, no fluctuation. The cyst which originated at the lower border of the left lobe of the liver was first drained with a cannula, two pints of fluid being removed, and the cyst wall was then dissected out.

In Brown's case, which was found during an autopsy on a man aged

sixty-eight years, the cyst was the size of a large orange and occupied the fissure of the suspensory ligament. It was smooth and globular and adherent to the left and quadrate lobes and to the stomach. The walls were thick and showed calcareous plates and the contents were tenacious, bile stained, mucoid fluid. The liver, gall-bladder and other abdominal organs were healthy. Brown says, "It appears to have originated in the accessory bile-ducts that are occasionally found at the left end of the transverse fissure."

Doran's case was in a woman aged forty-two years, who gave a history of injury followed by abortion in a few hours, three years before admission. Four months before admission jaundice began, then occasional vomiting, and enlargement of the liver. Large fluctuating swelling to the right of umbilicus. On operation a cyst was found occupying the quadrate lobe and the whole of the left half of the right lobe. Two and one-half pints of deep green bile were removed by aspiration. Gall-bladder and ducts were normal and the jaundice was probably caused by pressure. In this case Doran suggested that the injury might have caused the rupture of a duct inside the liver, followed by the slow extravasation of the bile into the bruised liver substance around it, thus forming a cystic cavity. (Most authors agree that subcapsular rupture of the liver can lead to cyst formation.) This case, like Mayo Robson's, was entirely intrahepatic.

Aldoas reports a case in a woman aged forty-three years who had had a swelling, which was painless, in the epigastrium for twelve months. On operation, a solitary cyst arising at the free border of the liver was found and twelve pints of thin dark fluid were evacuated. Gall-bladder was normal.

In Winckler's report of Von Glotz's case over 6000 c.c. of fluid were evacuated in two sittings, and autopsy showed a right-sided hydro-nephrosis due to pressure on the ureter from a large cyst of the under surface of the liver.

Konikow's case was in a woman who had jaundice for fifteen years with pain in the liver region and six weeks before admission a swelling. Operation revealed a cyst the size of a child's head attached by a broad base to the right lobe of the liver. The cyst was opened and a part of its wall was resected, while the remainder was sutured. A small sinus persisted for one and a half years afterward. Microscopic examination showed it to be a cystadenoma of the bile-ducts.

As these cysts are not apt to give rise to symptoms until they become of sufficient size to cause pressure, they are usually diagnosed post mortem. They may be mistaken for a distended gall-bladder, cystic liver, echinococcic cyst, gumma, or cyst of some neighboring organ.

The operative results in solitary cysts have been satisfactory and the procedure should be as radical as is consistently

safe; in those cases in which enucleation can be done without excessive hemorrhage, this is the best method; in cases where there are very firm attachments and there are other contraindications, it is best to suture the cyst wall to the parietal peritoneum and drain. Simple puncture is to be condemned.

CASE REPORT.—J. L., colored, aged fifty-one years, widowed, mother of seven children. Health fairly good until about five years ago, when she began to have excessive bleeding from a uterine fibroid. In April, 1908, a hysterectomy was performed at the Rutherford Hospital, and a fibroid weighing five pounds was removed together with a cyst of the right ovary which weighed six pounds. At this operation the gall-bladder was inspected and if the cyst was present it escaped detection.

In June, 1911, the patient began to have pain in the epigastrium, which was always worse when the stomach contained food; beyond a slight resistance of the right rectus I could detect nothing abnormal and as the colon was loaded with fæces, I advised her to take some castor oil and report herself again.

In December, 1911, the patient returned very much run down and there was plainly visible as well as palpable a small rounded mass in the middle line above the umbilicus, resistant on pressure, and with a distinct transmitted pulsation. Because of the position of the mass and of the fact that it moved with respiration, a tentative diagnosis of tumor of the left lobe of the liver was made and under ether anæsthesia the abdomen was opened on Dec. 31, 1911, by a medium incision and the lower border of the left lobe of the liver presented in the wound, showing a firmly encapsulated cyst the size of a small orange.

The surrounding liver tissue was of normal texture. The cystic area was darker, and enlarged veins showed on the surface. The sharp margin of the liver at this point was obliterated and the mass was spherical in outline. At its upper margin and near the centre was a small, firm mass irregular in outline and about 2 cm. long by 0.5 cm. broad. Except for this the outer surface was perfectly smooth. An aspirating needle was introduced and over 200 c.c. of almost clear fluid was withdrawn. The remainder was removed by narrow strips of gauze packing. The lining membrane of the cyst was smooth and resembled normal peritoneum. After evacuation of the fluid there was left

a cup-like cavity in the liver which felt more resistant than normal liver tissue. On account of the general weak condition of the patient and the firm and extensive attachment of the cyst it was considered best to suture it to the parietal peritoneum and drain it, which was done, the abdomen being closed in the usual manner.

None of the cyst wall was excised but examination of the fluid removed was entirely negative. It was slightly cloudy, alkaline, specific gravity 1005, and contained albumin. Microscopic examination showed nothing whatever save cellular detritus.

Convalescence was normal and the drainage tract entirely closed in four weeks. Seven weeks later the patient's general health was much improved.

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GAS CYSTS OF THE INTESTINE.*

PNEUMATOSIS CYSTOIDES INTESTINORUM HOMINIS.

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INTESTINAL pneumatosis is a chronic, probably a self-limited process, consisting of the formation of gas cysts, which may occupy any layer of the intestinal wall, the gas acting as a foreign body which gives rise to inflammatory changes and leads to the formation of giant-cells.

The views of different observers on the origin of intestinal pneumatosis vary widely, and will be considered later on under the headings of the various theories that have been advanced to explain the occurrence of the disease. The majority are in favor of a bacterial genesis, but unless the intercession of additional factors be conceded, this view is weakened by the absence of inflammatory changes, and the disappearance of the characteristic vesicles, after simple laparotomy; last, not least, by the fact that no typical bacteria have as yet been found. The assumption of a mechanical entrance of gas into the tissues presupposes the existence of gaps, or defects, passing from the epithelial layer of the bowel into the interior of the mucosa. This condition has never been positively established; at any rate, an existing communication between the epithelial gaps and the fully developed vesicles can always be constructed as a secondary process, due to the gas contained in the cysts.

In a general way, the emphysematous areas in the intestine have been remarkably free from local ulcerative processes; but practically all the reported cases of intestinal pneumatosis, with detailed clinical histories and autopsy protocols, show the presence of gastric or duodenal ulcers, or at least

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symptoms pointing to some chronic disease of the intestinal tract, which has existed for a number of years (35 out of 44). Of the other cases which we have been able to tabulate, two patients had tuberculous peritonitis, two chronic appendicitis, one carcinoma of the stomach, one pulmonary tuberculosis and emphysema, one volvulus, one post-operative peritonitis, and one suffered from chronic cardiac disease.

The following case seems to be of interest, not only on account of its rarity, but because also of the unusual opportunities afforded for bacteriological and pathological examination.

The patient, a Chinaman, fifty-seven years old, a laundryman by trade, was admitted to the service of Dr. A. B. Johnson, at the House of Relief on January 18, 1911. He gave a history of indefinite abdominal pain for several months previous. His appetite had always been good and he had never vomited; about eight o'clock in the morning on the day of admission, he was suddenly seized with a very severe cramp-like pain in the epigastric region. He vomited and his abdomen is said to have rapidly begun to swell. At three o'clock in the afternoon, he was brought to the hospital in an ambulance. When seen on admission he showed all the symptoms of a perforation of either the stomach or the duodenum, and an immediate operation was decided upon. The usual incision was made and on opening the peritoneum a large quantity of gas escaped, and the whole cavity was found to be distended with a serosanguineous fluid, almost clear. Over one and a half gallons were removed by the aspirator, and a culture was taken. It was then seen that several loops of the small intestine, lying in the right lower quadrant, were matted together and covered by hundreds of small cysts, many of them pedunculated and containing gas. When punctured these cysts promptly collapsed with the escape of air. Cultures were taken from the interior of these cysts and several vesicles were removed intact for examination. A perforated gastric ulcer was found, but as the patient was failing very rapidly, it was thought best to attempt to stop the leak in the stomach with a piece of omentum, upon which a cigarette drain was firmly placed. This was done and the wound closed. The patient grew slowly weaker, failed to respond to stimulation, and died at eleven o'clock that night.

We were fortunate to be able to obtain an autopsy, which was done by Dr. Symmers, of the New York Hospital, nine hours after death, a synopsis of which is as follows:

On opening the abdominal cavity, it was found that the parietal peritoneum was diffusely swollen and in places slightly reddish in color, but for the greater part it was pale, lustreless, and thinly covered by fibrinous exudate. There was considerable excess of cloudy fluid in the larger fossæ of the abdomen and pelvis. In the interval between the cardiac end of the stomach and the inner surface of the spleen, a number of soft rice granules were floating free in the fluid exudate. The serosa of the intestines was swollen and opaque, irregularly covered by serofibrinous exudate; and the small gut was thrown into numerous loops, which were matted together by a fibrinous substance. In the right lower quadrant of the abdomen, a dozen or more coils of the small intestine were bound together by serofibrinous exudate, forming a large, convoluted, sausage-like mass, and in the peritoneal covering were dozens of pale, tense bullæ that collapsed on section, with the escape of air. The smallest of these blebs approximated the size of a split pea, while the largest was about the size of a crab apple, and each was covered externally by peritoneum. On exposing the mucous surface of the gut corresponding to the distribution of the gaseous bullæ, large numbers of pin-head sized emphysematous vesicles were found irregularly scattered beneath the epithelial lining; otherwise the mucous membrane showed no noteworthy naked-eye changes. Large and small emphysematous blebs were also observed dispersed through the peritoneum in front of both kidneys.

The stomach was considerably distended by gas and by a quantity of semifluid material, consisting largely of macerated granules of boiled rice. The upper border of the lesser curvature in the region of the pylorus was firmly attached to the under and inner surfaces of the gall-bladder by dense, pale adhesions. In the upper border of the stomach, just to the inner side of this mass of adhesions, was a rounded perforation 1.5 cm. in diameter. The perforation involved all the coats of the stomach, and its edges were thin, pale, and smooth. On opening the stomach, an enormous ulcer came into view, involving the upper border of the lesser curvature and the posterior wall of the stomach just to the inner side of the pyloric orifice. It was irregularly rounded and approximated the size of a silver dollar. The base of the ulcer was pale and smooth. In places, the edges were composed of soft, œdematous mucous membrane, which overhung the base of the ulcer in the form of polypoid projections. In other places the edges of the ulcer were thin, smooth, and sloping. The perforation noted in the description of the external aspect of the stomach lay at about the centre of the ulcer in the lesser curvature near the pylorus.

The result of the bacteriological examination, done at the Pathological Department of the New York Hospital, is as follows: A drop of fluid taken from the peritoneal cavity at the time of the operation was inoculated into 100 c.c. of sterile bouillon. At the end of 24 hours the

medium was diffusely cloudy. A drop of the growth was then placed on agar and streaked consecutively over the surface of three plates. After 24 hours, the plate showed a growth of *Proteus*, *Bacillus lactis aërogenes* and *Bacillus coli communis*.

Anaërobic cultures, taken on Loeffler's serum from the emphysematous blebs in the peritoneum of the small intestine, showed the presence of numerous large Gram-positive bacilli. The organism was slightly smaller than the *Bacillus lactis aërogenes* of Welch, but belonged to the same family (Dr. Elser). It was not practicable to establish the identity of this organism more definitely.

The outcome of the pathological examination was as follows: The mucosa was not in a perfect state of preservation. As far as could be determined, it appeared to be atrophic and very poor in lymphoid elements. The muscularis also was not well developed, and especially the circular coat was thin in places. The cystic process was situated altogether outside of the longitudinal coat and was therefore subserous (Fig. 1). The cysts were irregularly oval in shape, some considerably elongated, varying in diameter from about 1 mm. to 2 cm. The innermost layers of the wall of the cysts varied somewhat. In some of them, there was a single layer of flattened endothelial-like cells, containing one elongated spindle or ovoid-shaped nucleus; but in such cysts, probably on account of tangential section, a few of the cells presented larger, apparently swollen, nuclei, or were even multi-nuclear (Fig. 2). Such giant-cells were particularly noticeable where a slight detachment of the lining had taken place. The exceedingly sharp and linear edge along the inner aspect of the endothelial-like cells in some of the cysts, and the presence of a sharp refractive substance in others, limiting many of the cells internally in the form of short or even quite long crystal-like fascicular bodies, is a curious and unexplained feature. Possibly, the needle-like appearance is due to rupture of a continuous lining membrane.

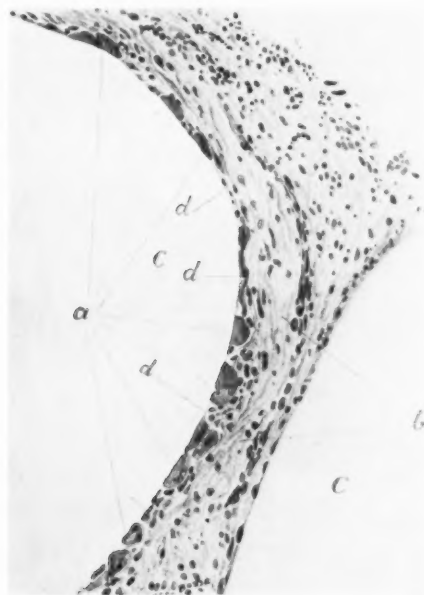
For the most part, the sections of the cysts were completely devoid of contents, except for occasional stellate and needle-like bodies (see chemist's report). In some places, however, an irregular zone of slightly granular substance, staining deeply with hæmatoxylin, adhered to the lining of the cyst, but usually occupied only a very small part of the cavity. There were no cellular elements in this substance, except those detached from the cyst wall. Another type of cysts showed a lining in which the cellular elements seemed to have suffered from marked com-

FIG. 1.



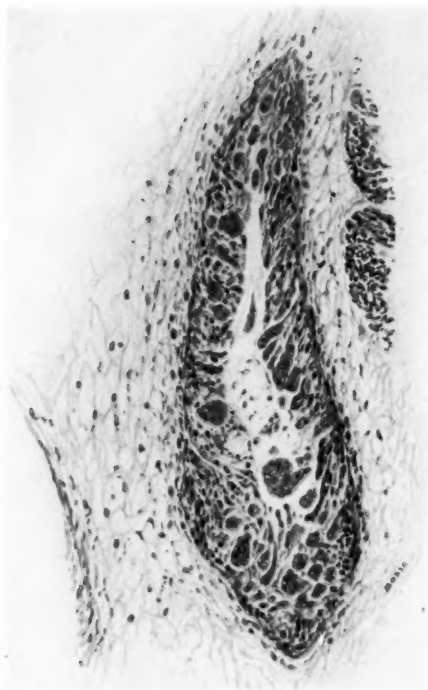
Low power. Transverse section of gut, showing subserous disposition of the gas cysts, *a*, mucous membrane; *b*, subserous cysts; *c*, attenuated muscularis.

FIG. 2.



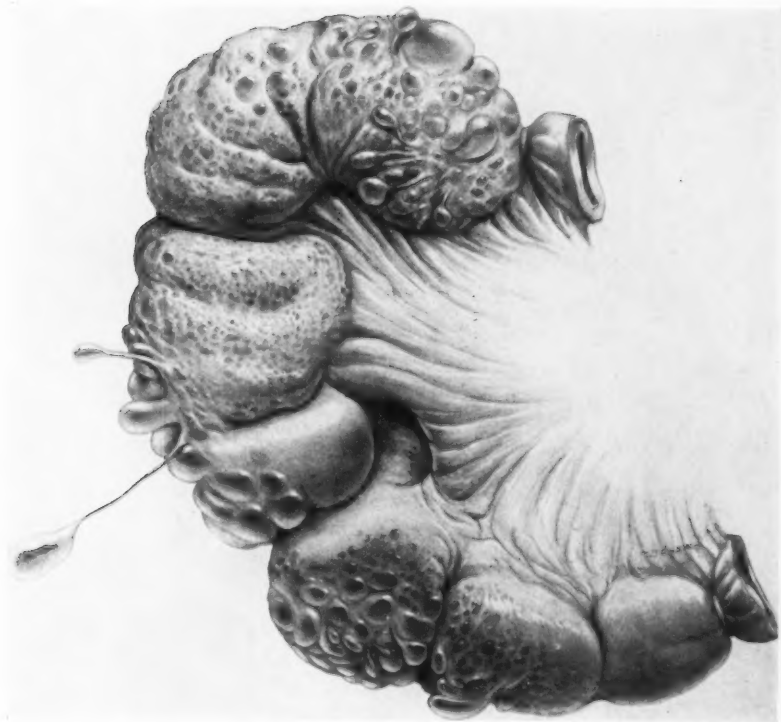
Illustrating the typical lining membrane of a gas cyst. The space to the right is bounded on the left by a connective tissue of septum bearing endothelioid and giant multinucleated cells whose flattened inner aspect is characteristic; *a*, giant-cell lining; *b*, connective-tissue septum; *c*, interior of cyst; *d*, sharp edge.

FIG. 3.

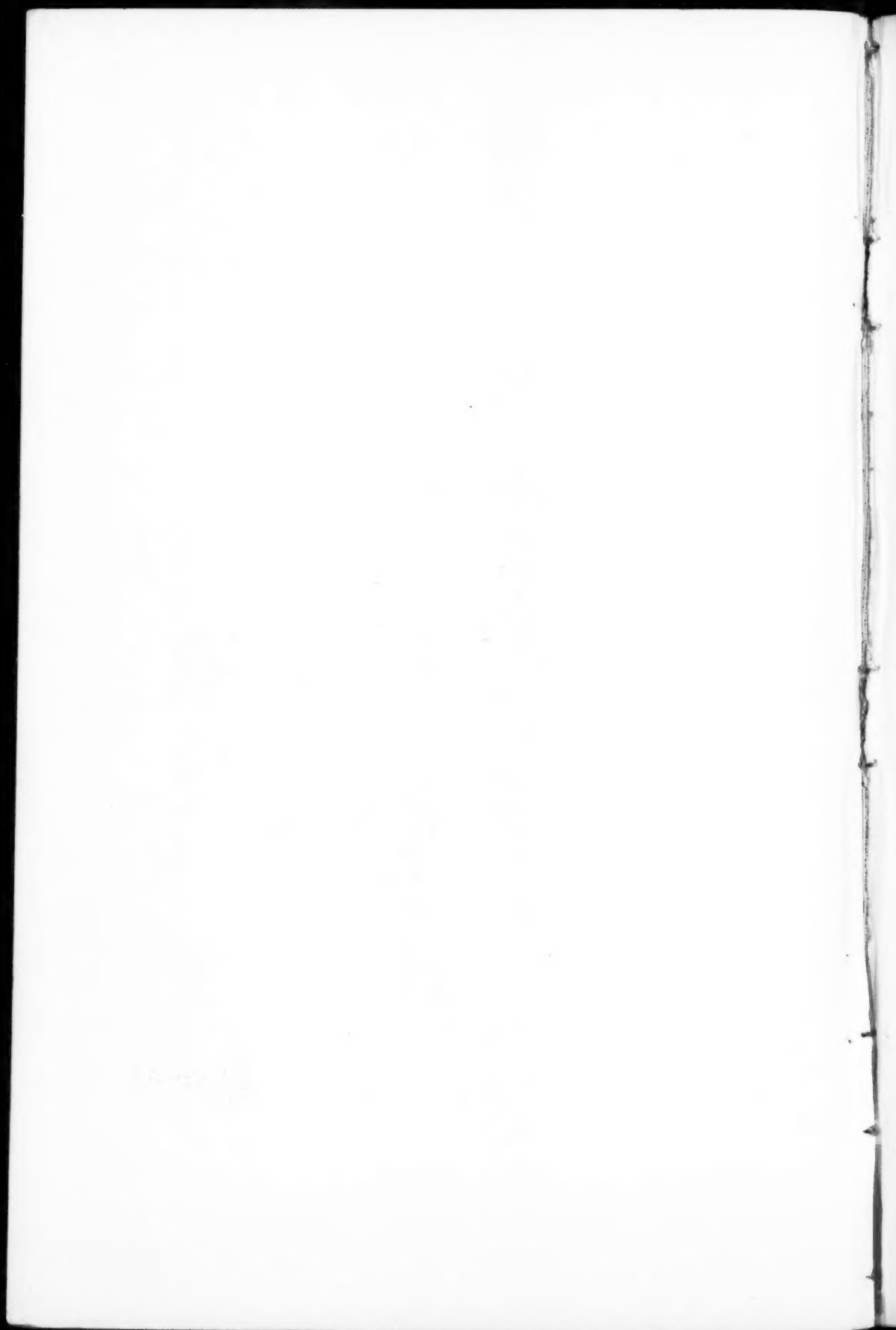


Typical giant-cell focus. Such areas may at first sight suggest a vein. Note the giant-cells in the lumen.

FIG. 4.



Showing general appearance of involved part of small intestine.



pression, so that only an occasional nucleus with a faint, long-drawn-out spindle-like body remained as evidence of the cellular nature of the lining membrane. In such cysts, however, the endothelial nature of the cells became apparent in those places where a tangential section brought more of their bodies into view. Here the atrophic effect of pressure was seen in the small size of the nuclei.

These cyst linings may be regarded as having cells of an intermediate type in which the lining is made up of elements that vary greatly in size and shape, in places being of an endothelioid type, in others having a polygonal shape, and in still others being giant-cells with two or more nuclei.

In the connective-tissue septa between the larger cysts, channels were found whose walls at first sight gave the impression of belonging to a vein or large lymphatic. These were lined with a membrane composed of a large number of giant-cells (Fig. 3). The lumen of the channel contained detached giant-cells. The mixture of small round cells, of spindle-cells, and the partial liberation of giant-cells from the walls made a somewhat confusing picture. Doubtless such appearances are due in part to tangential sectioning and to the desquamation incident upon imperfect fixation. In such channels, there is a marked proliferation of spindle- and endothelial cells, and they lie intermingled with the giant-cells.

The outer walls of these giant-cell channels, when thin, were composed of a number of layers of spindle-shaped cells simulating smooth muscle. The arrangement of the cells in a concentric fashion around the lumen of the channel, although for the most part fairly distinct and easily differentiated from the surrounding connective tissue, was not always prominent enough to warrant considering it a true theca. In many instances, the cellular elements in the surrounding connective tissue and the young connective-tissue elements, probably of an inflammatory nature, with numerous round cells and polynuclear leucocytes, encroached upon these giant-cell foci, making the recognition of a limiting wall almost impossible.

This proliferative, and in part inflammatory process had led to a marked thickening of the walls of these giant-celled channels. Here, collections of endothelial round cells and polynuclear leucocytes disposed with their long axis pointing toward the centre of

the focus were found, giving an appearance simulating the walls of a tubercle. The giant-cells can best be studied in those channels, for they often filled them, being completely detached from the walls. They presented a multitude of different shapes, there being as many as one or two dozen nuclei, usually occupying a median position in the cell. Besides this, polynuclear leucocytes were found in abundance between the giant-cells.

Where the section took in only the outer layers of these foci, the inflammatory zone can best be studied. In such places, collections of polynuclear leucocytes, round cells, plasma cells and epithelioid cells were found.

In the larger septa of connective tissue there were foci, which probably represent stages in the obliteration either of cysts or of giant-cell channels. These showed a peripheral zone of rather dense connective tissue, relatively poor in cells, the cellular elements being arranged in a radial fashion. Within this layer was enclosed an inflammatory nodule, containing numerous leucocytes, endothelioid cells, and a few giant-cells. Perhaps this is indicative of a healing process. The conversion of the loose connective tissue into dense fibrotic nodules and bands, such as form the outer zone of the focus described, was regularly seen in some of the sections; indeed, so much so, that veritable fibromata formed the striking feature of some of the sections. Thus, as an end result of the inflammatory and cicatrizing process, there were areas in which the cysts had become relatively few in number, as evidenced by the remarkable thickening of the septa. In the septa there were large fibrotic nodes made up of the connective tissue already described, in places undergoing a mucoid degeneration. A careful study reveals the fact that even these microscopic fibromata were the results of connective-tissue proliferation and obliteration of cysts, for an irregular space could often be detected in their centres. Even in the neighborhood of the nodules there were small collections of atrophic giant-cells, small polygonal cells, and endothelioid cells.

Sections of the gut taking in the mesenteric border and a portion of the mesentery showed typical cyst formation, with quite a marked inflammatory process in the connective-tissue septa. The cysts could be traced for a short distance into the mesentery, where their structure was the same as in the intestine. There was marked atrophy of the muscular coat, mucosa, and lymph follicles where cysts were present.

Examination of the gut near the termination of the cystic process, where as far as could be determined macroscopically there was a transition between minute cysts and normal intestine, showed the following pictures:

The mucosa is almost normal and the lymph follicles much larger than in the intestine heretofore described. The longitudinal and circular muscle is better preserved than in the region containing the cysts. Just outside of the longitudinal coat is new formed tissue forming a band somewhat thicker than the whole of the rest of the intestinal coats. This presents a meshwork, composed of a multitude of spaces, separated in places from the serosa by a thin layer of connective tissue, in others by dense fibroma-like tissue such as was described as forming nodes in other sections. There are areas in which the structure is that of a typical capillary lymphangioma, there being a multitude of fairly large lymphatics with thickened walls. Here and there are found marked dilatations of lymphatics, particularly outside of the muscular coats, forming cavernous spaces of considerable size, lined by endothelium and receiving or dividing into a number of lymphatic channels. Besides these spaces that are indistinguishable from capillaries, there are thin walled, irregularly shaped spaces, containing numerous bacilli, the lining being for the most part devoid of any distinct endothelial structure. In some of the cyst walls, a continuous layer of endothelial-like cells can be distinguished.

Were it not for the presence of the old connective tissue, one would conclude that the sections just described represent the most recent or youngest areas involved in the emphysematous process. It is more probable, however, that the lesion was inconsiderable at these sites and that absorption of the air or gas had taken place, with consequent cicatrization around the air-containing spaces.

Summary of the chief characteristics of the lesions:

1. Extensive gas cyst formation, for the most part situated outside of the longitudinal muscular coat.
2. Characteristic appearances of the gas cysts and the cyst walls, in which the presence of an endothelial-like lining and giant-cells is a feature.
3. Occurrence of spaces or channels, some of which may be lymphatics partly lined by endothelium and partly filled with giant-cells, endothelioid cells, and leucocytes.

4. Evidences of dilatation of lymphatics and of the inter-communication of large lymphatic spaces, possibly cyst spaces with undoubted lymph channels.

5. Absence of communication between cysts.

6. Inflammatory and productive processes between the cysts and under the peritoneum, resulting in the formation of connective tissue and fibromatous masses, leading to the obliteration of certain cysts and therefore to a kind of healing process.

7. Absence of bacteria in most of the cysts. (The bacteria present in some places are probably post-mortem invaders.)

8. The deposition of highly refractive needles (see chemist's report) in the interior of many of the cysts, causing a peculiar flattening of the cells belonging to the lining membrane, and the possible rôle of such crystalline matter, in the production of some of the giant-cells.

Chemist's Report.—The crystalline matter removed from the gas cysts is found composed of needle-shaped, translucent, homogeneous crystals, arranged loosely in sheaves. They are soluble in chloroform and ether, from which they readily recrystallize, assuming irregular, branched, crystalline forms. After treatment with dilute mineral acid and extraction with chloroform and ether, on evaporation of solvent the dissolved material fails to crystallize. There was not sufficient material for closer study, but the above would seem to justify the belief that the crystals represent soaps of the higher fatty acids.

The formation of small gas cysts in the intestine of animals has been known for a long time past. The disease was first described by Mayer, in 1825, in an otherwise healthy hog. The gas contained in the vesicles was found on analysis to resemble the atmospheric air. After the account of the disease by Mayer, the first description of the microscopical appearance in pigs was contributed by Roth, in 1896, who assumed a primary proliferating lymphangitis, with secondary excretion of the gas from the blood. After him, Schweitzer, in 1899, and Heydemann, in 1904, claimed that these animals always had intestinal catarrh with obstruction, causing a considerable accumulation of gas, which is under a high pressure, and is pressed into the lymphatics through small solutions in the continuity of the mucosa, thus forming cysts, and lymph-

angitis is added secondarily. A similar opinion is maintained by Kitt, in his text-book on the "Pathological Anatomy of the Domestic Animals," vol. i, 1905.

The disease had often been noted in hogs which were fed on the waste of dairies or cheese factories; and Ostertag, therefore, holds a yeast fungus responsible for its production. The culture of this fungus has not yet proven successful.

A liquefying coccus was grown in pure culture by Dupraz,⁷ 1897, who explained the cysts as the result of a proliferating lymphangitis due to gas-producing bacteria, which distend the lymphatics, and he claimed to have produced the cyst formation experimentally. Jaeger (1906) isolated from gas cysts of the pig's intestine a species of the colon bacillus, *Bacterium coli lymphaticum aërogenes*, and injected this germ into the wall of animals. A number of very small gas cysts were discovered at the autopsy, in all of the layers of the gut of these animals, which died within 25 hours from general infection. The existing difference from the typical pathological picture of intestinal pneumatosis is referred by Jaeger to the very acute course of his experimental cases.

The chronic course of this affection, which in pigs is restricted to the small intestine, is illustrated by the findings of the Bureau of Animal Industry of the Department of Agriculture in Washington (Dr. J. R. Mohler). A certain importance naturally attaches to the matter from the stand-point of meat inspection, so that the process was investigated and attributed to a micro-organism of the colon group. However, the transmission of the condition by experimental introduction of the pathogenic agent has not apparently been accomplished.

In the human subject, the formation of gas cysts was observed for a long time only in the vagina and urinary bladder of females, almost without exception during pregnancy. Although the condition clinically resembles vaginal emphysema (also known as cystic colpohyperplasia), the appearance under the microscope is somewhat different. Intestinal pneumatosis does not show inflammatory changes of the same severity as those noted in cystic colpohyperplasia. The resemblance con-

sists in the benign course of the two affections, their prolonged duration, and their dependence upon predisposing factors.

The origin of gas cysts of the intestine was referred by von Winckel to hæmatomata or to follicles and small glands. Hemorrhage was considered as the cause by Lebedeff. In the opinion of Chiari and Eppinger, the air entered the cysts from the outside, whereas Bang¹ claimed that the lymph is transformed into gas under the influence of giant-cells.

After a thorough study of his personal observation, by means of all known laboratory adjuvants, and careful sifting of the available evidence derived from other cases, it appears to the author that, taken by itself alone, neither the bacterial nor the mechanical theory satisfactorily explains the formation of these gas cysts of the intestine. Acting in conjunction, it becomes more plausible that this peculiar condition might develop in consequence of bacterial invasion, supplemented by mechanical minute solutions of continuity. Reasoning along the same lines, the presence of chemical factors suggests itself as a possible ally, in the complicated pathogenesis of this interesting affection.

Bacterial Theory.—This theory is endorsed by the majority of authors, who agree in referring the formation of the cysts to the action of gas-producing micro-organisms. There is much to be said in favor of this view, although it has not yet been placed on a positive basis. Its opponents claim that the bacterial findings are always debatable, and the results either of post-mortem change, or of a secondary bacterial invasion.

The first to arraign a coccus as the originator of emphysema (vaginal) was Klebs, in 1876, and this explanation was extended to gas formation in the intestine, by Eisenlohr,² 1888. Three years after him, Camargo³ reported similar bacterial findings, in a case of true pneumatosis cystoides intestinorum. The rods which Winands,⁴ 1895, was enabled to demonstrate inside and outside of the cysts were not accepted by the investigator himself as satisfactory evidence of a bacterial pathogenesis.

A French observer, Dupraz,⁵ claimed to have furnished the original and complete proof of the bacterial theory, through his demonstration of a microbe which presented certain resemblances to the lactic ferments

(1897). On the other hand, the bacteriological findings of Hahn,⁸ in Germany (1899) were not clear but contradictory; microscopical examination showed cocci in the cyst wall, but colonies of short rods grew from sheep serum that had been inseminated with the extirpated air vesicles. Although the rest of the examination proved negative, Hahn advocated the bacterial theory and assumed the transference of the pathogenic agent from infected pigs to the human subject.

Jaboulay,¹² 1901, without submitting any evidence (the cysts in his case were not disturbed in any way) was inclined to refer the condition to a gas-producing micro-organism. In the same year, Miwa's¹³ cultures from the cystic contents, on grape-sugar agar, yielded a growth of gas-forming bacteria, but no positive results were obtained in animal experimentation with these germs. He also demonstrated that a number of rods and cocci were present in the cystic walls and cavities. Another adherent of the bacterial theory is Nigrisoli,²⁰ 1903. Mori²¹ originally inclined to the bacterial theory, although no bacteriological examination was possible in his case, 1907. In the following year, 1908, Gröndahl²² expressed himself to the effect that the condition is probably the result of infection with a gas-forming non-pathogenic microbe, which gives rise to chronic lymphangitis and distends the lymph vessels and gaps into vesicles, causing a characteristic macroscopical and microscopical appearance. A species of gas-forming bacteria was held responsible for the genesis of the gas cysts by Jamanouchi,⁴⁰ 1909. The pathogenesis was referred to a bacterial agent, by Arzt,⁴¹ 1910; and he also accepted the identic origin of pneumatosis cystoides and colpolyhyperplasia cystica. Wasiljew,³⁸ 1910, endorsed the bacterial theory. Sherman and Wilkie,⁴² 1910, found no micro-organisms within the cysts or in their walls, and regarded some cocci and bacilli from interstices between cysts at the lower end of the ileum as the result of contamination of the specimen. A culture with the morphological and biological characters of the *Bacillus coli communis* was grown from cysts removed at the operation. The cultural findings agreed with those of Jaeger, 1906, and of the Department of Agriculture, in Washington, in cases of gas cysts of the pig's intestine. The action of germs (*Bacillus gasogenus*) resulted in the production of the gas, in the opinion of Martini,⁴³ 1910.

Mechanical Theory.—The adherents of this theory, the most recent advocate of which is Miyake,⁴⁸ 1911, refer the origin of the disease to a process entirely analogous to that of traumatic emphysema. The following facts, according to him, go to show that the genesis of intestinal pneumatosis is referable to mechanical causes, namely, that the intestinal gas escapes from minute ruptures in the bowel wall:

1. Absence of uniform histological structure of the gas cysts.
2. Close relationship between the gas cysts and the lymphatic apparatus.

3. Absence of all inflammatory signs in the tissues or in the cysts themselves.

4. Negative bacterial findings on culture as well as in sections.

5. Combination of intestinal pneumatosis with certain chronic gastric affections, which favor meteorism and lower the resistance against the escape of intestinal gas into the bowel wall.

6. Complete disappearance of the gas cysts, after simple laparotomy or enterostomy.

7. Similarity of experimental gas cysts, in rabbits, and human pneumatosis, both in appearance and histological findings.

8. Necessity for the combined action of several causative factors, in the experimental production of intestinal pneumatosis.

Changes in the lymph vessels are undoubtedly present in practically all these cases, and were already credited with a leading part in the production of intestinal pneumatosis by Winands,³ 1895.

Kolli,⁸ 1898, explained the cysts as perhaps due to the forcing of the gases in the stomach, during the act of vomiting, through the margins of a gastric ulcer into the loose subserous cellular tissue of the intestinal canal, where, for some reason, the gas failed to become absorbed. Verebely,¹⁷ 1901, assumed that the gas had escaped through fine solutions of continuity in the intestinal wall. For the explanation of the gas bubbles in his case, Thorburn,¹⁹ 1903, suggested that the gas was driven from the stomach into the omentum through a perforation and for some reason became encysted instead of being absorbed. In the opinion of Simmonds,⁴⁴ 1910, a lesion of the gastro-intestinal mucosa is indispensable to the entrance of gas-forming bacteria into the bowel wall. Urban,⁴⁵ 1910, explained the condition as the outcome of cystic dilatations of the lymph gaps and vessels, but left it an open question how the air enters into the cysts; apparently through minute lesions of the intestinal wall. Mori,³⁰ 1908, abandoned the idea of a bacterial origin in favor of a mechanical explanation, such as circulatory disturbances. Ciechanowski⁴⁶ noted the absence of bacterial agents in his first observation, and pronounced himself more definitely in favor of the mechanical theory in his recent contribution (1911), admitting, however, that the penetration of the gases into the tissue under the action of purely mechanical factors has never been unobjectionably demonstrated.

The adherents of the mechanical theory, as was pointed out by Nowicki,³⁴ 1909, are found mostly among veterinarians, who believe that in animals the gas penetrates into the mucosa through solutions in the continuity of the epithelium, especially on injuries from overstraining at work or lesions due to the presence of foreign bodies. As the process is often found associated with enterocatarrh, the gas has been assumed to enter the lymph gaps in consequence of the increased pressure within the bowel. Very hot or starchy fodder has also been

held responsible for an increase of gas pressure in the intestine, with penetration of the gas into the tissue.

Neoplastic Theory.—This explanation was offered for the first authentic case on record, that of Bang,¹ in 1876. The gas cysts were interpreted by this observer as a new growth, the centre of which had undergone degeneration, followed by liquefaction and a gaseous change of the contents. Kouskow,⁴ 1891, referred the cystic tumor found in his case to a congenital origin, the growth arising from the fixed elements of the connective tissue. The theory of tumor growth is strenuously supported by Mair,³⁰ 1908, who considers the gas cysts as analogous in structure and formation to the air bladder of fishes, and credits the cells of the tumors with the power of secreting gas. This view is endorsed by Finney,³³ 1908, who says that "the most rational explanation of the growth would seem to be that it is a definite entity, a distinct variety of tumor, the cells of which have the faculty of secreting gas."

Chemical Theory.—Taken in conjunction with Dupraz's demonstration, in a case of gastro-intestinal emphysema, of a microbe apparently related to the lactic ferments, and probably existing as a saprophyte in water, the following facts in regard to milk are very suggestive: The gases contained in milk are carbon dioxide, oxygen, and nitrogen. These gases are expelled in the course of heating; so that boiled milk has lost almost nine-tenths of its carbonic acid, and about one-half of its oxygen and nitrogen.

Dairymen are familiar with a peculiar gas-formation in milk, shown by a collection of gas vesicles under the cream; such milk is known as fermenting or framing milk. It contains large quantities of gas-producing bacteria, which do not necessarily belong to the coli ærogenous group, but include butyric acid bacteria, yeasts, and so forth. The most important gas producers are the coli ærogenes bacteria, which possess the property of decomposing lactose under the formation of carbonic acid and hydrogen; some being characterized by an especially strong capacity of gas formation. These germs live in large numbers on fodder plants, or the latter may

give rise to a marked increase of the coli aërogenes flora in the intestine, with transformation of the ordinary type into especially dangerous gas producers. It is usually a lack of lactic acid bacteria in the milk which causes a proliferation and over-activity of the ubiquitous colon bacillus. A possible formation of the gas from the blood of the vascular structures was taken into consideration by Hibler; and Deutsch, in the discussion of Verebely's¹⁷ case, suggested that the gas might originate through the protoplasmic function of the cells, instead of coming from the bowel wall itself; as, for example, the way in which gas develops in the cells of ripening apples, while no such gas is found in unripe fruit.

Bang claimed that the lymph is transformed into gas under the influence of giant-cells. More recently the origin of the giant-cells has been sought in the local irritation of the endothelial lining, by the gas contained within the cysts (Ciechanowski,⁴⁷ 1911).

NATURE OF THE GAS CONTAINED IN THE CYSTS.

It has been pointed out by Jaeger that examinations made on specimens that are not perfectly fresh are of no value, for the reason that a gaseous exchange with the atmospheric air takes place through the vesicular walls. In order to be satisfactory, the examination must be completed within three hours at the latest. The mixture obtained by him was as follows (*Verhdlg. d. dtsh. Ges. f. path. Anatomie*, Stuttgart, 1906-1907): CO₂, 15 per cent.; O, 5.6 per cent.; H, 73.3 per cent.; N, 6.1 per cent.

The chemical analysis of the gas in Urban's case, which was made in the Vienna University Laboratory for Medical Chemistry, led to the following findings: CO₂, 5.23 per cent.; marsh gas, 7.66 per cent. Two months previously, the examination of a specimen derived from the same case, in a chemical laboratory in Luiz, Austria, had shown the following composition of the gas: CO₂, 4.5 per cent.; O, 15.4 per cent.; nitrogen and hydrogen (marsh gas?), 80.1 per cent. The gas was considered as trimethylamin, by Zweifel, whose material was derived from a case of emphysematous vaginitis (*Archiv. f. Gyn.*, vol. xii, 1877).

The first positive case was reported by Bang in 1876; this was followed by Eisenlohr's case in 1888. Hahn, after whom intestinal pneumatosis is often called in Germany, was the first to treat a case by laparotomy in 1899. Then Ciechanowski states that in 1904 he was able to find 20 cases in the literature.

At the present time we have been able to tabulate 49 cases, the present case making the fiftieth. It should be noted that the new list excludes several cases reported formerly, such as Marchiafava's, which, although of much interest as showing great similarity in cell arrangement, contained fluid instead of air. The case reported by Maass, in 1904, appears to us to have been a post-mortem change. Two or three cases, where a delayed autopsy was done, have also been excluded on the ground that the gas cysts which were found were due to putrefaction.

ABSTRACTS OF CASES REPORTED IN LITERATURE.

1. BANG (*Nordisk Medizinsk Arkiv*, vol. viii, No. 18, 1876): In a case concerning a woman 57 years of age, who had died from volvulus, the lower portion of the ileum presented a large number of small gas cysts, from the size of a pea to that of a bean; no fluid but gas escaped on puncture of the vesicles. These cysts had a smooth inner surface and were found for the most part in the muscular layer, some also in the submucosa. The wall of the cysts consisted of a layer of fibrillar connective tissue, with an endothelial lining. The endothelial cells were very large and had a finely granular protoplasm, with 30 to 40 nuclei, or over. The newly formed tissue of the intestinal serosa contained cysts of a similar character, having the identical appearance of the above-described cysts. The interstices in the newly developed tissue were lined with cells having exactly the same configuration as the endothelial cells of the cyst wall. Although all transitions were found from these interstices to the extensive cysts, there was no demonstrable connection with the lymphatic vessels.

2. EISENLOHR (*Ziegler's Beiträge zur pathol. Anatomie.*, vol. iii, 1888, p. 101): The following case of intestinal and vaginal emphysema was observed in the Zürich Pathological Institute. The patient died from valvular disease of the heart, and came to autopsy four and a half hours after death. A number of intercommunicating cysts, with thin walls, were found in the submucous muscular and serous layers. These cysts were lined with endothelium on the inner surface, and contained numerous giant-cells; they communicated with lymph gaps and lymph vessels. Numerous finely granular collections of bacteria were found in the interior of the cysts as well as in the lymph capillaries and lymph spaces.

3. DE CAMARGO (*Thèse de Doctorat*, Geneva, 1891): At the autopsy of a man 60 years of age, who had died from pulmonary consumption, the cæcum and the ascending colon were found to be much contracted, and thickly studded on the serous surface with a mass of large and small cysts. The cysts occupied exclusively the submucosa. The septa between the individual cysts were in part very delicate but in part quite thick;

they were infiltrated with round cells. The inner surface of the cysts was provided with a lining of flattened endothelial cells; multinuclear giant-cells were also found scattered about. A connection of the cysts with the lymph vessels or lymph spaces could not be demonstrated. Numerous bacteria were found throughout, both inside and outside of the cysts.

4. KOUSKOW (*Boln. Gaz. Botkina Russ.*, October 7, 1891): At the autopsy of a man 57 years of age, who had suffered for years from symptoms of gastric ulcer and intestinal obstruction, several coils of the small bowel were found to be covered with a transparent cyst-like tumor. Gas escaped on incision of the membranous lining, which was found to be the shell of a number of separate cysts, varying in shape and size. Each small vesicle had a connective-tissue wall, lined by a membrane made up of flattened multinuclear giant-cells.

5. WINANDS, M. (*Ziegler's Beiträge zur Pathol. Anat. u. zur allgem. Pathol.*, vol. xvii, 1895, p. 38): The observation concerned a woman 49 years of age, who was for six years an inmate of the Marburg Clinic, under the diagnosis of chronic ulcer of the stomach. Intestinal puncture was performed on one occasion, on account of persistent obstipation and associated extremely severe tympanites; after temporary improvement, the patient succumbed to progressive exhaustion. At the autopsy (44 hours postmortem), a very peculiar change was found in the abdominal cavity, aside from the fundamental disease. The intestinal wall contained countless numbers of gas cysts, which were likewise scattered over the lining adhesions.

6. ORLANDI, E. (*Gazzetta Med. di Torino*, No. 40, 1896, p. 781): The patient, a man 33 years of age, was admitted to the hospital with symptoms of intestinal occlusion and alcoholic delirium. Temporary improvement was followed three days later by peritonitis and death. The autopsy showed, aside from fibrinous peritonitis, a number (7-9) of irregularly arranged swellings, up to the size of a nut, at Bauhin's valve. These cysts had the appearance of submucous neoplasms, and were of an elastic consistence; a large quantity of gas, without offensive odor, escaped on incision of the swellings. The intestinal mucosa presented no special changes.

Cultures were prepared from all these gas cysts, and a bacterium was obtained, in one instance even in pure culture, which gave rise to gas development also outside of the body. Rabbits, mice, and guinea pigs were killed by injections with this bacterium, but the autopsy yielded no characteristic findings, and no gas formation in the animal body was demonstrable in further experimentation.

7. DUPRAZ, A. (*Archiv. de Méd. Expér.*, vol. ix, 1897, p. 282): The observation concerned a woman 29 years of age, at whose autopsy (36 hours after death) the stomach was found to contain submucous vesicles in the large cul-de-sac, while other emphysematous vesicles covered the jejunum for some distance, as well as the ileum. The microscopical findings showed a dilatation of the lymphatic system, with formation of alveoli, with gaseous contents. The smaller alveoli presented

remnants of cellular necrosis on their wall, while the lymphatics of normal calibre were in a state of endothelial proliferation (proliferative chronic lymphangitis).

8. KOLLI (*Russki Vrach*, September, 1895; *Lubarsch-Ostertag*, vol. v, 1898, p. 212): In a fatal case of gastric ulcer, numerous vesicles filled with air, and varying in size from a pin's head to a walnut, were found under the serosa of the duodenum and the adjacent coils of small intestine.

9. HAHN (*Deutsche med. Wchschrft.*, 1899, p. 657): The patient was a man 35 years of age, who after suffering for two years from a stomach disease supposed to be gastric ulcer, began to present symptoms of intestinal trouble, in form of prolonged diarrhoea, later on replaced by persistent obstipation; there was also a sensation of fulness with anorexia and progressive emaciation. Soft, elastic, painful resistances could be felt under the sternum and in the abdomen. Operative interference finally became necessary, and the laparotomy showed the larger part of the small intestine as well as the entire colon to be closely studded with countless cysts, from the size of a pea to that of a bean, partly pedunculated, partly attached by a broad base to the serosa. The cysts contained exclusively a non-combustible gas, but no fluid; compression caused them to burst, with an audible noise. As the cysts could not be radically removed, a number were compressed and burst open between the fingers.

The patient visibly improved after the simple laparotomy, and was discharged in good condition, at the end of about seven weeks.

10. KORTE (*Discussion of Hahn's paper*, *Dtsch. med. Wchschrft.*, 22, 1899, p. 255): At the autopsy of a woman 62 years of age, who had died under symptoms of peritonitis seven days after a hernia operation, the walls of the small intestine were found to contain a number of sharply outlined cystic tumors, from the size of a pea to that of a cherry. Bubbles of air escaped from these cysts when they were cut open under water. The microscopical examination showed the site of the cysts to be the intestinal submucosa.

11. WIKERHAUSER (*Centralblatt für Chirurgie*, 1900, No. 37, p. 938): In the case of a patient 35 years of age, who had suffered for ten years from gastro-intestinal disturbances, laparotomy showed beside pyloric stenosis, a number of globular clusters of cysts, from the size of a hempseed to that of a small cherry, studding the small intestine. The vesicles were either attached separately by a small pedicle opposite to the mesentery, or they were arranged in large or small groups, surrounding almost the entire periphery of the bowel. In color these cysts were reddish or bluish, transparent or white, traversed by fine capillaries. They crepitated under the finger, and were inflated with air. Some of the growths were extirpated for microscopic examination, which showed that the internal surface was mostly lined with normal endothelial cells, hypertrophied, and arranged in two to three layers. When the patient came to autopsy, having succumbed to peritonitis about two months after the operation, not a trace was left of the pneumatosis in the entire abdominal cavity.

12. JABOULAY (*Lyon Médical*, vol. xcvi, 1901, p. 753): In the course of operation upon a man 50 years of age, with a history of eight years'

gastric dilatation, due to cicatricial pyloric stricture, the small intestine was found to be covered with numbers of gas cysts, from the size of a pinhead to that of a hazel-nut. Another cluster of gas cysts was seen on the diaphragm near its centre. The cysts were neither removed nor interfered with in any way by the operator.

13. TOLOR (*Lyon Médical*, 1901, vol. xcvi, p. 955): In the course of a laparotomy on a man 52 years of age, with cicatricial pyloric stenosis, a large number of cysts were discovered on the peritoneal surface of the small intestine. No cysts were seen on the transverse colon, but several vesicles, some of them with a pedicle, appeared on the lower surface of the diaphragm. The intestinal cysts varied in size between that of a currant and a gooseberry; they were transparent and apparently situated underneath the serosa. Notable improvement followed upon the simple exposure of the cysts to the air, combined with digital dilatation of the pylorus.

14. VALLAS-PINATELLE (*Lyon Médical*, vol. xcvi, 1901, p. 215): The patient, a man 48 years of age, was operated upon as an emergency procedure under symptoms of acute intestinal obstruction or perforative peritonitis; death on third day following operation. The autopsy, 30 hours after death, showed the presence of a peculiar tumor, the size of two fists, a polycystic structure resembling a hydatid mole, which occupied a circumscribed segment of the jejunum. Clusters of cysts were found arranged along one metre's distance, followed by isolated cysts on the next metre of the bowel; the remainder of the ileum and the entire large intestine were normal. The vesicles varied from the size of a pea to that of a large nut. An odorless gas escaped on puncture or compression. The walls were thin and transparent, but continuous, and the gas could not be squeezed into the intestine, nor from one cyst into another. There was no cadaveric putrefaction. Some of the cysts were also noted on the parietal peritoneum and on the diaphragm.

Histological examination showed that the cysts were subserous and had very thin walls, made up of a connective-tissue stroma apparently devoid of endothelium, and with a very variable vascularization.

15. PELNAR (*Bull. Int. de l'Acad. de Méd.*, vi, 1901): This observation was made in a case of chronic tuberculous peritonitis. The cysts were mostly found in the intestinal submucosa, and were without an endothelial lining. The peritoneum presented no gas-cyst formation.

16. MIWA (*Centralblatt für Chirurgie*, No. 16, 1901, p. 427): At the autopsy of a man 42 years of age, countless vesicles were noted on the ileum, as the most noteworthy change; a segment of bowel about 30 cm. in length was studded with a number of gas cysts, from the size of a hempseed to that of a pigeon's egg, considerably narrowing the lumen of the intestinal canal. These cysts were all attached by a broad base; on compression they burst with a loud report. The gas contained in the cysts was odorless and non-combustible.

Microscopical examination showed no characteristic bacteria in the vascular contents. Although gas was formed in sugar cultures, animal

experiments (intraperitoneal cultures in two rabbits and two dogs) had a negative outcome.

17. VEREBELY (*Wiener mediz. Wchschrft.*, No. 47, 1901, p. 2218): Pneumatosis cystoides of the intestine, involving four coils of the ileum and the entire cæcum, was discovered as accidental findings in the autopsy of a man 30 years of age, who had died from pulmonary consumption and also had tuberculous abscesses in the intestine. The vesicles were in part attached by a pedicle, and in part with a broad flattened base. The mucosa was likewise infiltrated by innumerable vesicles, which contained an odorless, non-combustible gas. The microscopical examination showed the main seat of the cysts to be in the intestinal submucosa.

18. KADYAN (*Russ. Chir. Archiv.*, H. 6, 1902; *Centralblatt f. Chirurgie*, No. 10, 1903, p. 300): The following case was observed by the author in 1893. The patient, a woman 31 years of age, had been suffering for two years from abdominal pains, vomiting, alternate diarrhoea and constipation, and ascites. At the time of the laparotomy the intestinal serosa, especially of the small gut, was seen to be irregularly studded with tubercles of variable size, as well as air-containing vesicles up to the size of a plum. The condition was at first improved, but the operation had to be repeated about two and a half months later; the solid tubercles had disappeared, but there were again many air-containing vesicles, which were punctured and emptied or cut off after ligature of the pedicle, as at the first operation. At the third laparotomy, two months later, whitish spots were seen instead of the tubercles; again, there were numerous air-containing vesicles and a large amount of ascitic fluid. Considerable improvement again followed upon the operation.

Microscopical examination of the cysts showed fibrous walls lined with one or more layers of large endothelioid cells.

19. THORBURN, W. (*Med. Chronicle*, Manchester, vol. iv, 1902-3, p. 255): Gas-containing cysts were found in the omentum of a woman 42 years of age, who had suffered for ten years from dyspepsia and recurrent vomiting. At the operation were found gastric ulcers, perigastric adhesions, an enormous dilatation of the stomach, and two collections of rounded cystic masses, lying like saddlebags across the omentum, and extending into the right hypochondrium, or beneath the spleen, respectively. The numerous cysts varied in size from that of a small pea to that of a walnut, and were closely packed together in form of a cone, resembling a cluster of hydatids. Each little cyst had a thin, transparent but well-defined wall; some contained a thin, almost colorless fluid, but the majority were filled with an inodorous gas. The first mass which came into view was excised, but the collection on the left side was left behind, as there was evidently no malignancy. The patient recovered from the operation, but died about ten days after her discharge, presumably as the result of hemorrhage from an unhealed ulcer.

20. NIGRISOLI (*Nuovo Raccoglitore medico*, Sept., 1902): Gas cysts were discovered in the course of gastro-enterostomy upon a young man, aged 25 years, on account of cicatricial pyloric stenosis. Numerous

vesicles, round or oval, from which escaped an odorless non-combustible gas, were found on the mesentery and on a coil of small intestine, about 30 inches long. At the autopsy, three weeks later, no trace of the cysts was left on the intestine or on the mesentery.

The microscopical examination showed that the cysts had a connective-tissue wall and an endothelial lining.

21. V. HACKER (*Wiener klin. Wchschrft.*, Nos. 12, 14, 1903, pp. 368, 430): Before the Innsbruck Scientific Medical Society, meeting of January 17, 1903, was shown a man 42 years of age, upon whom an exploratory laparotomy had been performed on account of obscure intestinal disturbances. Aside from a gastric ulcer at the fundus, multiple gas cysts, from the size of a hempseed to that of a pigeon's egg, were found on several portions of the small bowel, chiefly occupying the convexity. Individual groups of these partly pedunculated structures were removed for examination. The vesicles burst on pressure with a slight report, and contained a colorless, odorless gas.

The histological examination, by Hibler, showed that the gas cysts were lined with a single layer of endothelial cells; similar layers were likewise found in gas-free serum-filled spaces. There were no recent inflammatory changes, no giant-cells, and no necrotic areas.

22. CIECHANOWSKI (*Wiener med. Wchschrft.*, No. 1, 1904, p. 24.): Gas cysts of the intestine were found at the autopsy of a woman 24 years old, who had died from gastric hemorrhage. The ileocaecal region was occupied by three swellings, attached to the side of the ileum opposite the insertion of the mesentery, and composed of numerous large and small gas cysts. The vesicles were filled with a colorless and odorless gas; in size, they varied from that of a pinhead to a pea. The inner surface was smooth and glistening; there was no apparent communication between the cysts.

Histological examination showed the cysts to be mostly situated in the thickened subserous tissue, in part outside of the external elastica of the bowel wall, which presented gaps in these localities. The submucosa contained cysts in only a few isolated areas. Careful microscopical and bacteriological examinations served to show that no etiological part was played in this instance by bacterial agents.

23, 24. STORI (*Clinica Moderna*, Pisa, x, 1904, p. 481): Case I: In the course of operation upon a woman 38 years of age (gastro-enterostomy for pyloric stenosis and gastric dilatation) a round mass consisting of transparent cysts from a pinhead to a bean in size was found lying above the gastrohepatic ligament. The cysts contained an odorless non-combustible gas. Part of the mass was removed for examination, and the cystic walls were found to be made up of connective tissue lined with a layer of endothelial cells.

Case II: In the course of operation upon a man 30 years of age (gastro-enterostomy for pyloric stenosis) the ileum near the caecum was found to be surrounded for about a metre's length by a greyish lobulated mass, springing from the mesentery, and made up of separate transparent cysts, from the size of a pinhead to a small hazel-nut. The cysts con-

tained an odorless, non-inflammable gas. Part of the mass was removed for examination, with the same findings as in the first case.

25. VISCONTINI (Gazz. degli Ospedali, No. 118, 1904, p. 1249): Transparent gas-containing cysts were found on the intestine, mesentery, and parietal peritoneum of a girl 13 years of age, in the course of a second laparotomy on account of dilatation of the stomach after pyloric stenosis. New vesicles were seen to form as the hand was passed over the peritoneum, while some of the cysts coalesced into a tumor the size of a hen's egg. The gas had no odor of hydrogen sulphide. Microscopical examination of the excised specimens showed a solid layer of connective tissue, with a few endothelial cells at the inside of the cysts. Recovery.

26, 27, 28. LUBARSCH (*Verhdlg. d. dtsh. Pathol. Gesellschaft*, x, 1906, p. 256): Three cases of gas cysts of the large and small intestine in human beings, which were carefully examined, presented the typical histological findings of lymph cysts with giant-cell formations. Bacteria were not demonstrable by means of any method.

29. MORI (*Dtsch. Ztschrft. f. Chir.*, vol. xxxviii, 1907, p. 553; vol. xci, 1907-8, p. 620): The patient, a man 37 years of age, was operated upon under the diagnosis of gastric dilatation beside which the following condition was discovered along the entire course of the small intestine: Except the first portion of the ileum and the terminal portion of the jejunum, the intermediate segment was studded with countless air vesicles, from the size of a hempseed to that of a hazel-nut, partly attached by a broad flattened base, partly suspended from a pedicle. The cysts were arranged in groups or scattered separately. A segment of intestine with gas cysts was reserved for histological examination, which showed the absence of an endothelial lining to the cysts.

After being considerably improved by the gastro-enterostomy and enterostomy, the patient had a relapse of his old disturbances, and returned for operation eight months later. At this time, all the innumerable cysts had disappeared absolutely, except two small hydatid vesicles with serous contents.

30. MAIR, W. (*Medical Chronicle*, March, 1908, p. 422): In the course of operation upon a young man (gastro-enterostomy for pyloric stenosis) the small intestine was found to be covered with a cystic tumor mass, for a distance of about nine inches; these cysts were separate from each other and varied from a barely visible size to that of a walnut. On puncture most of the cysts collapsed, under escape of an odorless gas. A few vesicles contained a small amount of fluid. The microscopical examination showed an endothelial lining in a number of the cysts, with multinuclear giant-cells lying free in the cyst cavity and also in the cyst walls.

31. MITCHELL (Quoted by Mair, *Med. Chronicle*, xiv, 1907-8, p. 422): Gas-containing cysts were found in the performance of a gastro-enterostomy for pyloric obstruction on a young man. Resection of the affected segment of small intestine was followed by recovery.

32. GRÖNDAHL, N. B. (*Dtsch. med. Wchschrft.*, No. 21, 1908, p. 913): The patient was a man 31 years of age, healthy until six years ago, when

dyspeptic symptoms developed and became gradually worse, leading to marasmus and death after protracted gastric hemorrhage of several days' duration. At the autopsy the ileum was seen to be covered for about the distance of one metre with innumerable cysts, up to the size of a bean, forming grape-clusterlike projections or floating like simple vesicles on a long slender pedicle. The cysts were all attached to the free margin of the bowel as far as the mesenteric insertion, but without involving the mesentery.

The microscopical examination showed the absence of gas cysts from the intestinal mucosa, which was unchanged; whereas the submucosa and also the thickened serosa contained numerous gas cysts, lined with a more or less distinct endothelium and surrounded by a layer of connective tissue. The submucosa also contained collapsed cysts with numerous enclosed cells, mostly lymphocytes, and many large multinuclear giant-cells. Apparently a communication existed between the lymph vessels and the cysts.

33. FINNEY, J. M. T. (*Jour. Am. Med. Assoc.*, Oct. 17, 1908, p. 1291): In the course of operation upon a man 60 years of age (gastro-enterostomy as a palliative procedure for the relief of suspected carcinoma), "a curious soft multinuclear cystic tumor, 15 cm. (6 inches) long by 8 cm. ($3\frac{1}{4}$ inches) wide at its widest point, was found attached to the free border of a loop of ileum about one foot above the ileocecal valve." The cysts were very numerous and varied from microscopical size to that of grapes; each cyst seemed to have a thin fibrous wall of its own, which burst on puncture with an audible noise, indicating considerable pressure. The gas contained in the cysts was odorless and non-combustible. Portions of the mass were removed for histological examination, and were found to be composed of a loose fibrous tissue surrounding spaces of very irregular size, part of which were provided with an endothelial lining and multinuclear giant-cells. The endothelial cells as well as the cells of the adventitia presented swelling or ballooning, and numerous cells apparently belonging to the connective tissue were similarly enlarged and filled with great vacuoles, lending a very loose appearance to the entire tissue.

34, 35, 36. NOWICKI (*Virchow's Archiv.*, vol. cxviii, 1909, p. 143): (1) At the autopsy of a man 22 years of age, who had died from valvular disease of the heart and chronic gastro-enteritis, the following condition was noted in the large intestine: The mucosa of the transverse and descending colon showed transverse elevations up to the size of a nut, separated by deep furrows; these elevations, to some extent also the smooth mucosa, were studded with greyish, transparent, round gas vesicles, of an average size of 3 mm. A characteristic crepitation was heard on compression or incision. The vesicles did not change in position under pressure. On removal of a slice of the uppermost layer, the bowel presented a sponge-like appearance, while the outer surface, *i.e.*, the intestinal serosa, was smooth and free from visible changes.

(2) At the autopsy of a man 41 years of age, who had died from chronic myocarditis and chronic gastro-enteritis, similar findings were noted as in the preceding case, in form of cystoid pneumatosis of the

cæcum and ascending colon. The elevations as well as the interstices presented an enormous number of uniformly scattered round vesicles, which contained gas and had a diameter up to 5-6 mm.

(3) Kucera's case: This observation was made on a man 39 years of age, who had died from pulmonary tuberculosis. The process was limited to the transverse and descending colon; the vesicles were located in the mucosa and submucosa, reaching an average diameter of 4 mm. The serosa presented no visible changes.

37. HERMAN (*Lek. Gal. Tyg. lekarski*, No. 8, 1908, p. 118): In this case, which is quoted by Nowicki as having been demonstrated before the Przemyszlau Galicia Medical Society, the intestinal pneumatosis had developed as a sequel to gastric ulcer.

38. VASLYEFF (Wasiljew) (*Centralblatt f. Chirurgie*, No. 16, 1910, p. 594): The patient, six months after appendectomy for acute appendicitis, began to suffer from pain in the cæcal region and intestinal disturbances. Laparotomy was performed, under the assumption of adhesions; none were found, but the lower end of the small intestine was distended by numerous gas cysts, lined with peritoneum, which burst and disappeared on pressure. Resection of the affected segment, 7 cm. in length, was followed by recovery.

The mucosa of the resected intestinal segment was unchanged; the submucosa was thickened and interspersed with gas-filled cavities; the muscular layer was fairly unaltered; the bulk of the gas cysts occupied the serous layer (lymphangitis proliferans).

39. WOLTMANN, A. N. (*Centralblatt f. Chirurgie*, No. 17, 1909): The patient was a man 37 years of age, who presented the symptoms of chronic appendicitis. The appendix was removed, but five months later the pain returned and remained constant. Laparotomy showed the absence of adhesions. A tumor, consisting of gas vesicles, was found on a coil of small intestine, at the side opposite the mesentery. The vesicles were separated from one another by peritoneal septa, and communicated in such a way as to give the tumor the appearance of a hydatid mole. An isolated vesicle was found higher up on the peritoneum. The affected segment of intestine was resected, and the isolated vesicle was crushed.

40. JAMANOUCI (*Verhdlg. d. Japan. Gesellschaft f. Chir.*, 1909): Laparotomy was performed upon a patient 29 years of age, who since his seventeenth year had suffered from gastric disturbances, leading to the diagnosis of pyloric and intestinal stenosis. In addition to gastric dilatation, due to cicatricial pyloric stenosis, a number of gas cysts were found in two segments of the small intestine, one 100 cm. and the other 70 cm. in length.

41. SHENNAN, TH., WILKIE, D. P. D. (*Jour. of Pathology and Bacteriology*, vol. xiv, 1910, p. 259): At the operation of a man 32 years of age, masses of gas cysts springing from the wall of the ileum were observed, besides pyloric stenosis, with a dilated and hypertrophied stomach; the patient died 30 hours later. The post-mortem examination showed a mass of closely set, thin-walled, transparent cysts, varying in size from

that of a hempseed to that of a hazel-nut; some were sessile, others were pedunculated; all were tense, and their contents were evidently gaseous, the cysts collapsing on puncture. None of them contained fluid, but one or two were filled with altered blood clot. The cysts occupied altogether about 54 inches of the ileum; a line of similar but smaller cysts was found on the under surface of the transverse mesocolon, in the hepatic flexure; a few cysts were scattered over the under surface of the transverse colon about its middle; the jejunum was free from cysts and so was the large intestine, except the parts mentioned. The cysts in the lower end of the ileum were evidently of longest duration, the vesicles becoming less numerous, less prominent, and apparently of more recent age, in an upward direction.

On microscopic examination, the cysts were found to have developed in the submucous coat and on the serous surface. Large giant-cells were observed in the innermost layer of the cyst wall, with fairly distinct margins and many nuclei.

42. WIESINGER (*Centralblatt für Chirurgie*, No. 16, 1910, p. 577): A specimen of gas cyst of the bowel wall, obtained at an operation for ileus, from a woman 67 years of age, was presented before a surgical society. A movable tumor the size of a small fist had been palpable above the umbilicus, and was found connected with the ileum at the operation. Another coil of small intestine was adherent to the tumor and was bent at a sharp angle. One coil was resected, and the other had a piece excised from its wall. The tumor was found to be cystic but contained air instead of fluid. Recovery.

43. ARZT, L. (*Frankfurter Zeitschrift f. Pathologie*, vol. vi, Feb. 1, 1910, p. 85): The patient was a man 30 years of age, who had suffered from gastric disturbances since 1906. The condition gradually became aggravated, and laparotomy was performed in January, 1909. After the peritoneum had been opened in the middle line between the xiphoid process and the umbilicus, the entire visible portion of the abdominal cavity was seen to be filled with large and small vesicles, between the size of a cherry and that of a hen's egg, studding the great omentum. Vesicles of the same character were seen also in the serosa of the small intestine, being especially numerous at the side of the coils opposite the insertion of the mesentery. These vesicles, which were filled with gas, could be removed by blunt dissection. After the ablation of a large number of the vesicles, a posterior retrocolic gastro-enterostomy was performed, and the abdominal wound was closed. The further course was unimportant; the patient was discharged cured three weeks after the operation; the improvement persisted one year later.

Principal results of the histological examination: (1) formation of cysts, single or multiple, in the intestinal wall, in the subserous tissue, with transformation of the endothelial lining into giant-cells in isolated areas; (2) undoubted lymph capillaries, with the lumen almost entirely obliterated by numerous giant-cells, developed in part at least from the endothelium of the lymph capillaries; (3) slit-like or rounded cavities

lined with peritoneal epithelium and communicating with the peritoneal cavity.

44. SIMMONDS (Discussion of Arzt's case at the fourteenth meeting of the German Pathological Society, Erlangen, April, 1910): A similar observation was referred to in a patient suffering from gastric ulcer.

45. URBAN, K. (*Med. Wchschrft.*, No. 30, 1910, p. 1750): The patient was a girl of 13 years, and the diagnosis of tuberculous peritonitis was rendered on the basis of the clinical findings. At the time of the laparotomy, half a litre of clear serous fluid escaped. No nodules were seen on the bowel or peritoneum, but the entire small intestine, the cæcum, and a piece about 20 cm. in length of the ascending colon were much distended, and the wall was interspersed with countless transparent, not communicating, vesicles, from the size of a pea to that of a hazel-nut, which caused the serosa to bulge, and gave it a roughened appearance. The vesicles collapsed on puncture, with escape of an odorless gas, apparently non-combustible. Lit in the dark, in larger quantities, this gas was seen to burn with a faint blue flame. The mesentery as well as the parietal peritoneum were entirely free from vesicles. The mesenteric glands were enlarged but not caseated.

Further intervention, such as enterostomy or resection, was omitted, in view of the extensive distribution of the process. At the relaparotomy, seven weeks later, nothing remained of the vesicles, but the serosa was covered with an enormous mass of light nodules, resembling millet seeds, which occupied the place of the former vesicles. Only a piece about 50 cm. in length of the lower jejunum was closely studded with cysts and very sharply outlined from the rest of the bowel. This segment was excluded by entero-anastomosis.

The histological examination of several extirpated cysts showed the vesicles to lie in the submucosa, pushing apart the mucosa on the one hand and the annular and longitudinal muscle on the other; they were lined with flattened endothelial cells or giant-cells.

46. MARTINI, E. (*Giornale della R. Accad. di Medicina di Torino*, Nos. 3, 4, 1910, p. 129): In the course of an operation for supposed benign pyloric stenosis, a new formation of cystic appearance came into view, covering a large portion of the intestine. The findings consisted in soft greyish or pearly masses of variable size, more or less pedunculated, and crepitating on pressure; these masses consisted of a variable number of light round cysts, transparent like soap-bubbles, from the size of a millet seed to that of a pea. The cystic new formation occupied only the convex portion of the bowel, and involved the entire length of the ileum; the calibre of the intestine was unchanged.

Macroscopical examination of some excised masses showed these to be formed of a conglomeration of thin-walled vesicles, which were united by highly vascularized connective-tissue septa. These vesicles floated on water, and an odorless, non-inflammable gas escaped when they were incised.

Microscopical examination showed a supporting connective-tissue framework, containing numerous enlarged capillaries, with the character-

istics of simple as well as cavernous angioma. Beside and between the blood lacunæ were seen cavities of variable size, rounded shape, and cystic appearance, lined with a layer of flattened endothelial cells. These cavities were for the most part empty; some contained individual more or less well-preserved blood elements and blood pigment.

47. CIECHANOWSKI (*Virchow's Archiv.*, vol. cciii, 1911, p. 170): The patient was a woman 46 years of age, who died in the hospital under the diagnosis of pulmonary tuberculosis and emphysema, without having presented any special symptoms on the part of the intestine. The autopsy showed pneumatosis cystoides, limited to the large intestine; the changes began directly at the ileocæcal boundary, comprising without interruption the entire cæcum, ascending and transverse colon, reaching as far as 10 cm. below the splenic flexure, where they terminated very abruptly. The colonic mucosa in the affected segments was uniformly bloated by gas cysts in the submucosa, which was interspersed with innumerable vesicles from the size of a pinhead to that of a pea. The contents of the cysts consisted of a colorless and odorless gas.

The microscopical examination confirmed in a general way the macroscopical findings, showing the submucosa to be the main seat of the gas cysts, whereas the subserosa was unchanged. Collections of giant-cells, surrounded by cellular connective tissue, were found in cyst-free upper layers of the submucosa, above the deeper cystic layers.

48. MIYAKE (*Archiv. f. klin. Chir.*, vol. xcv, 1911, p. 437): The patient was a physician 45 years of age, who during the last seven years had four attacks of acute and very severe pain in the ileocæcal region, and two similar attacks in the left iliac fossa. Radical operation was performed under the diagnosis of chronic recurrent appendicitis. Beside this disease, pneumatosis was discovered, affecting a coil of the ileum, and exactly corresponding to a resistant spot in the umbilical region which had been found tender on pressure in the preceding examination. The coil of ileum, about 10 cm. long and at a distance of 338 cm. from the duodenojejunal fold, was studded with a mass of gas vesicles, from the size of a lentil to that of a pea, arranged like grape clusters, mostly attached with a broad flattened base, in part pedunculated. The vesicles were either transparent, bluish, or pinkish in color, in part traversed by a fine vascular network. Beginning at the insertion of the mesentery the conglomeration of gas cysts covered about three-fourths of the circumference of the intestinal tube, leaving one-fourth of the bowel uninvolved, on the side opposite the insertion of the mesentery. The vesicles burst on compression with an audible report; the gas contained in them was odorless and non-combustible. The remaining intestinal segments were found to be free from vesicles on careful inspection of the exposed coils. The coil of ileum affected with the pneumatosis was resected to a length of about 10 cm.; this was followed by circular junction of the two stumps. The patient made a prompt and very good recovery.

49. ELSE PHILIP (Inaugural Dissertation, Leipzig, 1911): The patient, a carpenter 23 years of age, was under conservative treatment two years ago for perityphlitis. Eight days before admission to the clinic he was

suddenly attacked by severe abdominal pains in the right side; the condition became worse, and an operation was performed, which showed a peculiar configuration of the cæcum. The wall was made up of masses of globular structures, from the size of a sand grain to that of a hazel-nut; they appeared semi-transparent and filled with gaseous contents. Puncture of the cysts caused the gas to escape with a hissing noise, followed by collapse of the vesicles, which covered the entire cæcum and the lowermost segment of the ileum, terminating without a distinct boundary about 3 cm. above Bauhin's valve. A segment of omentum near the cæcum, but not adherent to it, was likewise interspersed by gas cysts of variable size, so as to form a tumor the size of an apple, which crepitated on contact. The mesocolon was swollen and emphysematous; it contained numerous swollen glands, one of which was removed for examination. A piece of omentum was likewise ligated and resected. The affected parts presented no signs of recent or chronic inflammation. The appendix was similarly emphysematous and infiltrated; it was resected, and the stump was buried through circular suture of the cæcum. Further surgical treatment seemed impossible, in view of the great extent of the gas infiltration, and was not attempted. As there was no trace of exudate and the appendix showed no gangrenous spots on macroscopical examination, the wound was closed by primary sutures. Next day, the patient complained of pain and pressure in the abdomen; the wound looked well and was not opened. The abdominal walls "crackled" very extensively, but inflammatory phenomena were absent. This crackling subsided promptly, the wound healed by first intention, and the patient was dismissed in excellent condition on the twelfth day after the operation. He was re-examined six months later, at which time he felt and looked perfectly well.

The report on the excised tissues and the appendix, from the Pathologico-Anatomical Institute of the University of Marburg, was as follows: The appendix shows a local, rather extensive necrosis, and in the surroundings of the necrotic area and the hæmatomata bacteria are demonstrable. The adjacent lymph vessels are much dilated, apparently through gas or air infiltration. Bacteria cannot be positively demonstrated in the lymph gaps themselves. The piece of omentum presents the same pneumatic dilatations of lymph vessels, likewise without demonstrable bacteria; remnants of a fibrinous exudate are found in certain areas in the dilated lymph vessels of the omentum.

The following observation of Duverney, 1747, quoted by Combalusier (*Pneumo-Pathologia*, 1747, p. 17), should be interpreted as a post-mortem gas formation, i.e., a putrefactive emphysema, in the opinion of Winands (*Ziegler's Beiträge zur pathol. Anat.*, vol. xvii, 1895, p. 38):

At an autopsy, a large portion of the intestinal tube was found to be studded with broad, long, annular swellings upon the outer membrane. These swellings seemed to be filled with a whitish substance, and on digital pressure yielded a crackling noise, like small air-filled vesicles. When opened, they were seen to be entirely filled with white, perfectly empty cells. On turning the bowel inside out, the same swellings were

likewise found on the internal side. Some of these swellings were so tensely stretched as to obliterate the lumen of the bowel. These swellings were therefore true emphysemata.

The observation of Cloquet (*Bulletin de la Fac. de Méd.*, vii, quoted by Andral, *Anatomie Pathol.*, ii, p. 175) can likewise not be admitted as a true case of intestinal pneumatosis:

A scrofulous patient, 20 years of age, died from vertebral caries in a state of extreme marasmus. At the autopsy soon after death, the cadaver presented no evidence of putrefaction. The cellular tissue between the various layers of the stomach was found to be very emphysematous; its walls appeared to be inflated, and in several places were nearly as thick as the thumb. The roughened mucosa was pale, and without a demonstrable lesion. The two anterior layers of the great omentum which are inserted at the greater curvature of the stomach were likewise separated by air. Similar conditions prevailed in the two layers of the lesser omentum. Collections of gas resembling the above were noted in other portions of the submucous cellular tissue, especially in the wall of the gall-bladder.

The treatment of this condition is the treatment of the fundamental or predisposing disease. Hahn, at the time of operation on his case, found the involvement of the ileum and colon so extensive that removal of the diseased bowel was considered impossible, so a number of the cysts were compressed between the fingers and ruptured. The patient made a good recovery after simple laparotomy and was considered cured seven weeks later. Mori states that in his case the patient after gastro-enterostomy was considerably improved, but suffered a relapse of his symptoms eight months later, which necessitated a second operation. At this time, the large number of cysts observed at the first operation had entirely vanished, except two small hydatid vesicles with serous contents. Kadyan had the opportunity of two secondary laparotomies on his case, the first two and a half months, the second four and one-half months after the first operation. At each time he noticed the number of cysts to be greatly diminished, practically none remaining at the third operation. Nigrisoli in the course of an operation for pyloric stenosis found many cysts on the small intestine. These were not interfered with, and at the autopsy three weeks later they had entirely disappeared.

Thus it would appear, concluding from the reported cases, and from the examination of our own pathological specimen in which obliteration of the cysts can be seen in many areas, that the condition is self-limiting, with a tendency to spontaneous cure. Therefore, if the predisposing cause be treated, there is no indication for resection of the affected bowel or even an attempt at removal of the cysts.

In conclusion I wish to express my thanks to Dr. Leo Buerger, of New York, for his complete and thorough examination and pathological report of the specimen furnished him from the case reported, and especially I wish to thank Dr. F. A. Robbins for a most exhaustive search of the literature and much help in preparing the abstracts.

THE ETIOLOGY OF KIDNEY CYSTS.

ILLUSTRATED BY A CYST DUE TO OBSTRUCTIVE CALCAREOUS PAPILLITIS.

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KIDNEY cysts have always created considerable controversy, particularly with reference to their genesis, which in most cases has been based on speculation rather than on absolute etiological foundation.

The case, which the author desires to report, proved to have a definite pathological cause for the production of the cyst, and is submitted as a representative of the retention theory of cyst-formation in the kidney, the retention being due to a sclerosis of one of the papillæ whose tip was incrustated with a calcium phosphate deposit.

This story is as follows:

Patient, male, forty-six years of age, single, farmer, was first seen in September, 1910, referred by Dr. Harvey G. Mudd. Complained of a dull aching pain in the right side, beneath ribs, of occasional reflection along the course of the ureter into the scrotum, suprapubic soreness, low backache, pain in the right hip, slight increased frequency of urination, and hæmaturia.

Family History.—Father died of cancer. No history of tuberculosis elicited.

Personal History.—Has always been healthy. Typhoid fever at twenty-one, uncomplicated. No venereal taints. Nothing to note in his past history.

Present Illness.—For several years has suffered with occasional aches in the small of the back and in the right hip, which were of slight consequence. A year and a half ago was suddenly seized with an acute colicky pain in the right side beneath the costal margin and right upper back. Pain was occasionally reflected along right side into the scrotum, lasted twenty-two hours, but was less severe after the first few hours. During the latter period he experienced more of a sickening ache than an acute

pain. He was quite nauseated but did not vomit. Morphia was not required. After the subsidence of the pain there remained no soreness in the side. The attack was accompanied by a slight increased frequency of urination, slight hesitancy, some slowness and diminished force of the stream. There was, however, no pain or burning on urination. At the end of the siege he voided a quantity of bloody urine, after which he was relieved, and the pain abated. Hæmaturia lasted several days, gradually fading away. The blood was always entirely mixed with the urine, never in the beginning or terminal. There were some clots. He did not pass "gravel." No chills, fever or sweats, but had creepy sensations. The aches in the back and hip ran parallel with the ache in the side, being aggravated during the colic and ceasing at the end of the attack. Patient has had five somewhat similar, though less severe attacks, during the last year and a half. The pain in the last attacks was never sharp, but of an aching, throbbing character. The hæmaturia was abundant in each attack, and lasted several days each time, gradually fading out. The last attack was two weeks before admission. For the past few months has had occasional soreness in the right side, between attacks. This soreness is always exaggerated on exercise, so that recently he has been unable to attend to his usual duties. There has been some diminution of the sexual appetite, erections more feeble than usual. There has been no pain on ejaculation or defecation. General health far below par. Appetite poor, and has lost twenty pounds in weight.

Status Præsens.—Voids every two and one-half hours during the day. Does not get up at night. Stream slow to start, is small, and is voided with diminished force. No pain or burning on urination. Slight soreness in the upper right side, and the usual ache in the small of the back and right hip. Urine bloody.

Examination.—Patient large framed, good color, tongue lightly coated. Pupils normal; no general glandular enlargement. There are multiple subcutaneous fibroid nodules scattered over the surface of the body. No tophi. Heart and lungs negative. Reflexes normal, no tenderness on palpation, kidneys not palpable, no tenderness in kidney regions, external genitalia normal. Urine glass, 1, 2, and 3, bloody; slightly acid in reaction, sp. gr. 1014, heavy trace of albumin. No sugar. Microscop-

ically, many r. b. c., w. b. c., epithelial cells, occasional hyaline cast, no granular casts, many colon bacilli. Urea 15 grams to the litre.

Rectal Examination.—Prostate moderately enlarged, distinctly indurated, particularly the right side. Slightly tender. Median furrow and notch shallow. Both seminal vesicles indurated. There is no intervesicular plateau. There are marked adhesions on the right side between the upper pole of the prostate and seminal vesicle and the lateral pelvic wall. The membranous urethra and rectum negative. No enlarged glands in the sacral fossa. "Prostatic secretion" contains a great many red blood cells, pus cells, and a few inactive spermatozoa. Stained specimen showed colon bacilli. Patient was put on hot rectal douches, rest, urotropin, and water in abundance. Two days later a cystoscopic examination was done with the following findings: Catheter passed easily. Recovered 250 c.c. of bloody residual urine. Bladder capacity 600 c.c. Cystoscope entered easily. Showed a definite rounding in the median portion of the prostate, amounting almost to a lobe, from the margin of which blood could be seen oozing quite freely; internal orifice otherwise normal. Both ureteral orifices normal in appearance and seem to be ejecting clear urine at normal intervals. Bladder wall normal, no stone, ulceration or trabeculation. With finger in rectum and cystoscope in the urethra, there was found slight thickening in the region of the median portion of the prostate.

Bleeding diminished slightly, and several days after the cystoscopic examination, the patient was endoscoped. There was found a large, dark-red, bleeding verumontanum and the whole posterior urethra extremely congested. Orifice of the utricle suggests nothing normal. In the light of the findings so far, it was thought that the symptoms were probably all of prostatic and vesicular origin, and that the pain in the right kidney region was one of the referred pains of prostatitis simulating renal colic. However, the patient several days before I saw him had been radiographed, and a shadow was found in the bony pelvis low down on the right side with the probable diagnosis of ureteral calculus. Kidneys were pronounced negative. In view of this, it was thought best to catheterize the ureters. This was done, and both catheters passed directly to the renal pelvis without obstruction and withdrew perfectly clear urine. The bladder

urine at this time was still bloody. The urinary examination on both sides was similar. Neither contained white blood cells, red blood cells, or bacteria. There were a few hyaline casts present on both sides; no albumin. Urea 15 grams to the litre on both sides. Functional test, phenol-sulphonephthalein was given. Six milligrams of the drug were injected hypodermically.

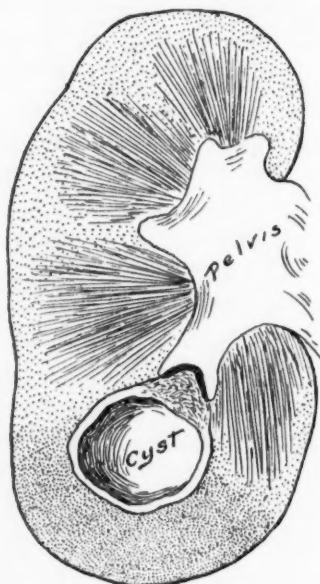
Time of Appearance; left side, eight minutes: first hour, 18 per cent., second hour, 13 per cent.; right side, nine minutes: first hour, 15 per cent., second hour, 12 per cent.

These findings seemed to substantiate the idea that the symptoms were entirely referable to the prostate, seminal vesicles and deep urethra. Not satisfied about the renal condition, ureter catheterization was again done with the same result as before, with the exception that a few red blood cells were found on centrifugalization. Patient was put on routine prostatic treatment with massage, irrigations, dilatations with the Kollman dilator, and applications to the verumontanum with silver nitrate. In three weeks he had greatly improved, the urine had cleared entirely, was free from blood. The prostate had decreased in size and the secretion contained fewer pus cells and only an occasional red blood cell. Five weeks after the institution of the treatment, the backache and suprapubic ache, and pains in the right hip had entirely subsided; urination free, voided every four hours, gain in weight five pounds. Cystoscopic examination at this time showed that the median rounding had greatly diminished in size and that there was only 20 c.c. residual urine. His only complaint at this time was soreness and an occasionally throbbing in the right side, beneath the costal margin. He was sent to Dr. Carman for a radiograph, and after a thorough fixation of the kidney with the Luffa sponge, the picture showed a very faint shadow in the region of the renal pelvis on the right side. On the strength of this picture and the finding of a few red blood cells in the centrifugalized specimen of the previous ureter catheterization, a right lumbar nephrotomy was done.

Operation.—Gas-ether anæsthesia. Oblique lumbar incision through muscles and fascia. Kidney slightly adherent at the lower pole. Delivered and was found slightly enlarged, particularly at the lower pole, which showed a slight rounding as in Fig. 1. Kidney was opened by the silver wire method suggested by Broedel. The lower pole of the kidney did not open in the

usual manner, owing to fibrous tissue changes. Upper pole opened easily and normally. Bleeding was slight, mostly from the lower portion. On opening the kidney, a rounded mass, the size of a walnut, presented in the region of one of the lower pyramids. By placing the hands on either side of the pelvis and invaginating it, it was found that the mass was a cyst which corresponded to one of the pyramids, and that the tip of the papilla was incrustated with the calcareous material shown in Figs. 1, 2, 3. The cortex in this region was denser than the re-

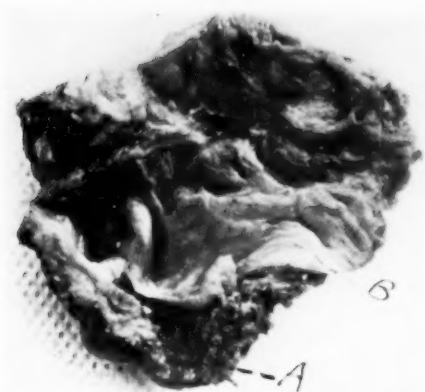
FIG. 1.



maining part of the kidney cortex and corresponded to the area drained by the papilla. There were no visible cysts in the cortex, but the kidney in this region was very sclerotic. The cyst was easily shelled from its bed, which was quite unexpected, and its attachment to the pelvis was cauterized with the Paquelin cautery. There were no signs of malignancy. The kidney was closed with interrupted mattress sutures of chromic catgut. Cigarette drain down to the kidney, wound closed in layers, except for the drain space. Skin closed with interrupted fine black silk. Silver foil dressing. Patient stood the operation well.

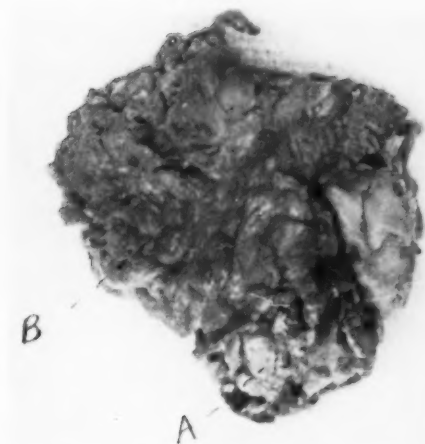
Post-operative course without event, similar to other pleasant

FIG. 2.



Anterior view. B, cyst lining; A, papilla with incrustation.

FIG. 3.



Posterior view of Fig. 2. B, cyst wall; A, papilla with incrustation.

FIG. 4.

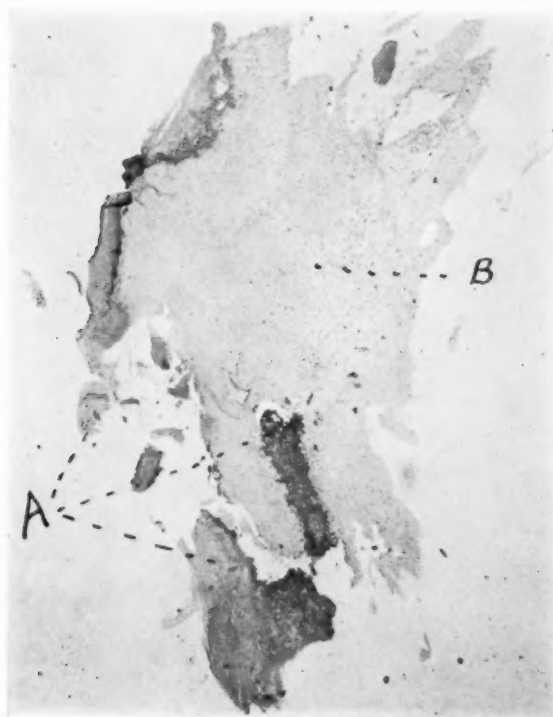
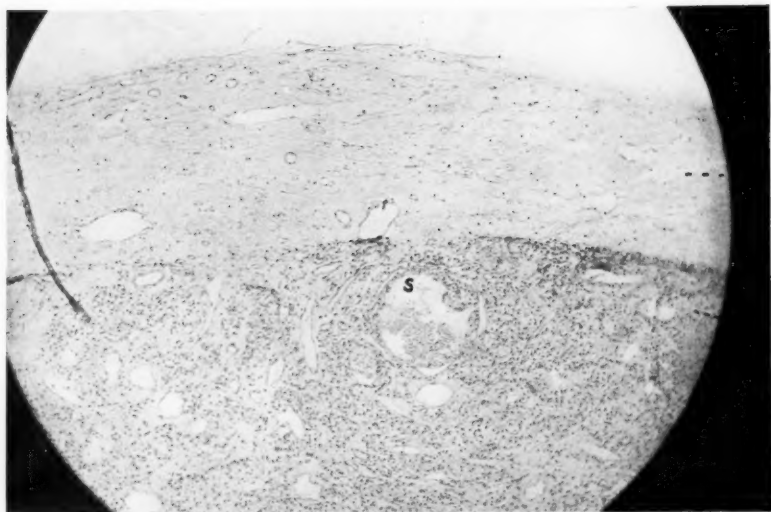
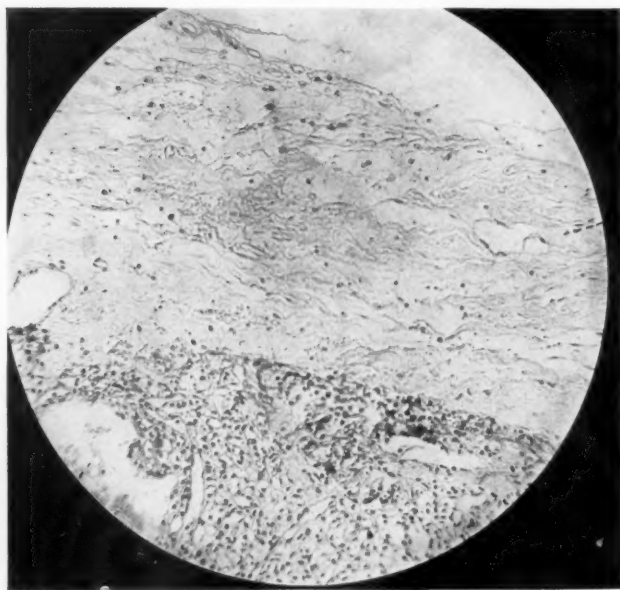


FIG. 5.



C, cyst wall; K, adjacent kidney tissue; S, small cyst lined by cubical epithelium.

FIG. 6.



nephrotomies. Left the hospital on the twenty-second day. Wound entirely healed. He was free from pain in his right side and gradually gaining strength. Patient was seen several weeks ago, says he feels perfectly well, is not suffering any pain whatever. Attends to hard farm work, urinates normally, has never passed blood since the operation, and has gained twenty pounds in weight.

Pathology.—Specimen consists of mass about the size of a small walnut, pyramidal in shape, tensely fluctuant, walls quite firm and at the tip there is a brownish calcareous material which covers it, as in Figs. 2 and 3. Specimen corresponds to one of the kidney pyramids with an incrustated papilla. On opening the mass, about a teaspoonful or more of clear amber-colored fluid escaped, which unfortunately was not saved for chemical analysis. However, it was found to be slightly alkaline in reaction. Sections were preserved in formalin 4 per cent. and blocks were made, one block was taken comprising the cyst wall and the tip of the papilla, which was incrustated with the calcareous material. This was decalcified in 5 per cent. nitric acid. Other blocks were made from the different parts of the cyst wall. All blocks were mounted in paraffin, stained with hematoxylin and eosin. A chemical analysis of the incrustation, made by Dr. Shaffer, Professor of Biological Chemistry, showed it to be composed almost entirely of calcium phosphate.

Microscopic Examination.—Section of the decalcified specimen made through cyst wall and papilla with the incrustation shows that the tip of the papilla is covered with homogeneous material which takes the deep blue stain of decalcified material, Fig. 4. This material projects into the substance of the papilla as can be seen in Fig. 4. The tissue of the papilla is dense and fibrous and contains very few cells. In immediate contact with this homogeneous material the tissue has undergone hyaline degeneration. In this hyaline area, as the calcified mass is approached, numerous minute calcified granules are seen. Deeper in the substance of the papilla the tissue is looser in texture and numerous small blood-vessels are seen. There are also occasional collections of lymphoid cells. The cyst wall is composed of dense connective tissue which in places is homogeneous. It has neither epithelial nor endothelial lining. It contains many dilated blood-vessels. Beneath the fibrous wall the spaces vary much in size and shape. The tissue contains numerous tubular structures lined by cubical epithelium corresponding to the renal tubules. Some of the spaces are lined with flat cells with deep staining nuclei, others with various gradations between flat and high cubical. There are several large cystic spaces in the wall, lined in places by flat epithelium and in other places destitute of any epithelial or endothelial lining. Their lumina contain desquamated epithelium and red blood cells. The vascular tissue between the tubules contains lymphoid cells. The interstitial tissue is increased in places and there is considerable blood extravasation. There are no signs of any proliferation of epithelium or

anything suggesting cystadenomatous changes. There are no glomeruli present in any of the sections, the cyst being entirely confined to the pyramid (Figs. 5 and 6).

There are several interesting reflections from the case to which attention is directed. In the first place, the diagnosis of the kidney lesion was quite difficult. The patient was thought to have a ureteral calculus from his history and from the first X-ray findings. The passage of a No. 7 ureteral catheter to the renal pelvis on each side, and the withdrawal of clear uncontaminated urine with no disturbance of renal function, seemed to eliminate the ureter as well as the kidney. Then with the definite high-grade involvement of the prostate, seminal vesicles and deep urethra, and the marked amelioration of symptoms after treatment was directed to them, these organs were thought to be the only offenders. Later examination with the ureter catheter and X-ray proved this not to be the case, as did the continuation of the renal pain after the other symptoms had subsided. We were dealing with a double picture. The urinary distress, hæmaturia, and the lower referred pains were undoubtedly referable to the prostate and deep urethra, and the upper pain to the kidney. The case demonstrated how careful one must be in attributing a pain in the renal region to lesions of the prostate, vesicles, and urethra. While the author has firm belief that such pains may originate from the genitals, still he feels that every possible means should be utilized to rule out the upper urinary tract before one makes his decision.

Whether the acute colic in the advent of the disease was due to plugging to one of the straight tubules of the papilla with a small concretion or to the breaking off of some calcareous material previously deposited, the author is not prepared to say, but is inclined to think the latter.

There are certain pathological features which seem worthy of special mention. The limitation of the cyst to the pyramid with its demarcation from the cortex is out of the ordinary. Why this happened, is uncertain. There is no anatomical reason for it. It may be that the cyst was in its infancy and

limited to the pyramid, and that in time it would have developed into a cyst of large size, occupying a great part of the kidney. I believe, however, that its full size was attained as the wall was quite thick and well developed. The most probable explanation of its limitation seems to be that it was a slowly developing cyst with an inflammatory reaction surrounding it which developed with greater rapidity than the cyst, thereby restricting its growth. The most striking observation in the case was the lesion of the papilla, which presented a dense sclerosis with incrustation of calcium phosphate, and which served as the cause of the cyst formation. The cause cannot be definitely determined as to whether the primary focus was a calcium infarct with a gradual deposition of salts and a secondary sclerosis or a primary necrosis with sclerosis and secondary calcification. It is most probable that it was the latter. It is extremely interesting that the process was confined to one papilla and that the others were, as far as could be determined, in a normal state of preservation.

Very little is written concerning inflammatory lesions of the renal papillæ with the exception of those following tubercular process, the varicosities described by Pilcher and Cabot cannot be included in this category. Papillitis and papillary sclerosis are not mentioned in the ordinary text books; and in a very careful survey of the literature I am able to find but few references to it. Virchow and Rayer speak of *pyelo-papillitis fibrosa* and consider the process the cause of kidney cysts. Kaufmann speaks of *desquamative papillary catarrh* which he found in association with uric acid and calcium infarcts and following the ingestion of certain poisons. Levaditi was able to produce a necrosis and secondary sclerosis of the papilla followed by incrustation of salts with vinylamin; and it has been found that certain drugs such as glycerine, iodoform, aloin, and formalin occasionally cause necrosis and sclerotic changes in the papillæ. It is to be noted that these descriptions are findings of research investigations and not clinical observations. The author has not been able to find any mention of the lesion in the perusal of the surgical litera-

ture at his disposal. The lesion presented in the above case of a dense papillary sclerosis with incrustation of calcium phosphate confined to one papilla, is as far as he has been able to determine, unique.

Pathogenesis.—The literature on the origin of kidney cysts is very voluminous and this paper will be presented in abstract. A full account appeared in the *Transactions of the American Association of Genito-Urinary Surgeons*, 1912. It will be sufficient to say that the main theories which have been proposed have been the retention theory, the new formation theory, the theory that colloid changes of the epithelial and connective tissue cells serve as an origin, the congenital theory and a theory proposed by Krause, which is that the kidney cysts are sometimes secondary to atrophy of the renal lobule in early life, corresponding to an obliteration of one of the branches of the renal artery. Later the lobule undergoes inflammation, fatty degeneration and cyst formation.

Each of these theories has had a long list of adherents, particularly the two important theories, that is, the congenital and retention, and even at present there is no unanimity of opinion. At a meeting of the French Association of Urology in Paris, in 1911, a symposium held on kidney cysts evoked the same unsettled state of affairs concerning their origin.

The idea is prevalent that cysts even of medium size cannot originate through obstruction of inflammatory origin, either from within or without the tubules. This is undoubtedly erroneous, as in the author's case there was a definite inflammatory obstruction and a fair size cyst. Evidently some of the cysts in so-called otherwise normal kidneys which have been thought to be of congenital origin might have been due to obstruction of inflammatory nature, as in early cases a careful microscopic examination in the region of the cysts was not made and it is possible that the lesion might have been overlooked. Those who contend that all kidney cysts are of congenital origin are unquestionably making a statement which is unjustifiable. It seems evident from a review of the cases which have been reported that some of the cysts must be considered of congenital origin, while the majority

seem to belong to the class of retention cysts following obstruction.

Etiology.—The etiology is obscure in most cases as can be observed from the study of the literature. Serous cysts are quite infrequent. In 2610 autopsies at the Middlesex Hospital, Morris met with but 5 cases. Israel found but one in 297 surgical affections of the kidney. Simon in 1906 collected 52 cases. The malady is one of adult life. Simon's report reveals but 7 under twenty years of age. Wagner's case, four years of age, is one of the youngest, and the case of Fox, seventy years of age, is one of the oldest. Males and females seem about equally liable to the disease. Albarran reports a slight advantage to the male, whereas Tuffier gives a proportion of 20 to 3 in favor of the female. Fowler reports 22 females and 12 males. Newman's 2 cases were both males. The right kidney seems to have been more commonly affected. Fowler gives a proportion of 22 to 10 in favor of the right. There seems to be no definite association with any particular disease, though many have reported such diseases as pneumonia, typhoid fever, dysentery, gall-stones and gout as precursors. Pousson says that any disease which is liable to produce nephritis may lend a hand to the production of kidney cysts. Certain drugs and poisons have been thought to be of etiological moment. Among them are corrosive sublimate, phosphorus, glycerine, aloin, vinylamin, etc. The method of cyst production is thought to be due either to a papillary necrosis with secondary incrustation with salts, as in the experiments with vinylamin, or to an infarct process with consequent papillitis, retrodilatation and cyst formation. The experimental work which has been undertaken with a view of producing cysts has been of two classes—the first being an attempt to produce an obstruction to the outflow from the tubules by various mechanical methods directed to their exit—the papilla, the second consisting in the administration of certain chemicals which seem to possess a selective action upon this particular location. Of the first type of experiments, those of Petterson and Tollens are the most significant. Petterson, after

bisecting the kidney, placed a silk thread in the papilla with the hope of setting up a progressive inflammatory reaction around the foreign body. He was never able to produce a cyst. The final result was atrophy.

Tollens cauterized single papillæ in order to get a definite localized obstruction. He studied the kidneys four, eight and a half, and twelve weeks after the experiment. At the end of four weeks there was complete obstruction of the ducts of the papillæ with retention of secretion and moderate dilatation of the canals of the cortex and the medulla, lined with cuboidal and flattened epithelium. After eight and a half weeks there was still dilatation, most marked in the straight canals, but no definite cysts.

It would seem that there are possibly two extremes exemplified in these experiments. In the first, it is probable that the foreign body did not cause a sufficient reaction to stimulate a progressive obstruction; hence, the result. In the second, by cauterizing the papilla there was produced a sudden complete obstruction. Under such circumstances one would expect exactly the results which were obtained, that is, a temporary dilatation with subsequent atrophy, similar to the results, if the same process had occurred in the ureter or in the excretory duct of any gland. Had the obstruction been intermittent, incomplete, or progressive, it is easy to conceive that a dilatation and cyst formation would have been produced, just as hydronephrosis arises under like circumstances.

A very interesting series of experiments, bearing upon this subject and representing the selective action of chemicals upon the papillæ, were conducted by Levaditi, who was able by subcutaneous injection of vinylamin to produce a papillary necrosis and sclerosis similar to the lesion described in the author's case. In his experiments he used mice, rabbits, guinea-pigs and goats, and was able to regulate the dosage in order to produce either an acute or chronic poisoning. In chronic poisoning there occurred a papillary necrosis with incrustation and retrodilatation.

Symptoms.—In surveying the symptoms referable to kidney cysts, one is impressed with their great variability. Cysts, when small, generally pass unrecognized during life and are usually post-mortem findings. If large, the symptoms depend upon the size, location, the pressure effects, the presence of infection and hemorrhage.

Pain is very fickle. In the cases examined, it was present in about 60 per cent. When present, it ranged from a dull ache to an acute colic, the former being the predominant type. It is generally located in the loin or hypochondrium. Radiation has been very infrequent. Hæmaturia rare. Lipskeroff's case, which was diagnosed ruptured kidney, was accompanied by profuse bleeding. Jower's case mentioned by Fowler was associated with hæmaturia. Increased frequency of urination has been described only in a few cases. Painful urination, rare. It was present in Hartman's case. The urine is generally normal in amount. Cysts of large size produce various pressure-effects, causing disorders of the gastro-intestinal tract, sensations of weight from the tumor, dyspnœa, weakness and emaciation.

Diagnosis.—The diagnosis has seldom been made, even in cysts of large size. Among the diagnoses which have been made are floating kidney (and it should be mentioned that the association of cysts with floating kidney has been observed in a number of instances), hydronephrosis, solid renal tumors, ovarian, splenic, hepatic, omental, pancreatic and mesenteric cysts, and ascites. The urinary findings have in most cases been negative. The cystoscopic ureter catheter and functional tests have usually failed in differentiating the lesion. X-ray has been of little service. However, Wulff diagnosed a solitary cyst of the kidney with the X-ray and had it confirmed at operation. The tumor, if large, is usually rounded, smooth, dull on percussion, at times fluctuant. The diagnosis of its renal origin depends upon the classical differentiation of renal tumors from other abdominal tumors; hence, it will not be described.

Pathology.—Serous cysts may be single or multiple, gen-

erally unilateral, situated either in the cortex (Morris) or the medulla (Follin, Duplay, Bouilly, Lanceraux). Terrier believes that the difference is due to the stage of development in which they are seen. He, with Cornil and Ranvier, believes it difficult to specify any elective part. The usual location is at one or the other pole. Terrier reports cysts six times in seven cases at the upper pole. Simon's 52 collected cases gave 18 at the lower pole, 8 at the upper pole, 8 at different parts of the kidney, such as the anterior surfaces, posterior border, and convexity.

These cysts vary markedly in size, ranging from a small walnut to the size of a child's head or larger. The case reported by Morris showed a tumor occupying the greater part of the abdominal cavity and weighing 16 pounds. Englander's case presented a cyst the size of a child's head. Von Brackel obtained two and one-half litres of fluid from his case. Rendu reports a cyst containing ten litres of fluid. Le Dentu believes that the position of the cyst bears a great influence on its size. Those situated in the cortex are usually small, while those in the medulla are usually very large. Sometimes the cysts communicate directly with one of the renal calyces. The cyst contents are also quite variable: sometimes clear and transparent, at other times turbid, gelatinous, or caseous. The color ranges from water-color to deep yellow, occasionally bloody. The reaction in most cases is alkaline; at times acid. Specific gravity, 1010-1020. The chemical constituents which have been found are chlorides, phosphates, albumin, serum globulin, cholesterolin, urea, and water. The presence of urea has created considerable discussion. Many authors, among whom may be mentioned Follin, Duplay, Bouilly, Desnos, say that one never finds any of the urinary constituents in the cysts. However, urea is frequently found, though generally in small amounts. Hemorrhages may occur in the cysts as the result of trauma or extravasation.

Microscopic.—The cyst wall varies in thickness from that of tissue-paper to one of considerable thickness and firmness,

and, at times, is calcareous. It is composed of dense fibrous tissue, scarce in cells (Le Dentu). In certain cases it is composed of stratified layers, more or less adherent. (Lamar). Lejars and Sibileau, in their cases, describe the cyst wall as being composed of a thick superficial reticulated wall, and a deep wall formed by pushed-up parenchyma in which one sees thrombosed veins. The cavity is divided incompletely by thickened bands which have the appearance of heart columns. Terrier has noted in the external coat, canals of different diameters, capillaries full of blood, arteries with endarteritis, and renal tubules. Hyaline changes have been frequently observed in the cyst wall. Smooth muscle and nerves have also been noticed. Concerning the lining of the cyst cavity, there have been great differences of opinion. Terrier says that wall is composed of fibrous tissue destitute of all epithelial lining, even in the depths of the wrinkles. According to Follin and Duplay, the wall is formed of a layer of connective tissue whose internal surface is smooth and serous in aspect, and is never covered with epithelium. Lejars has observed many plate cells, Leveran many thinned-out tubule cells, and Cornil and Babinski many pavement and cuboidal cells. Delkeskamp has seen cuboidal cells lining the cyst. Bonneau and Hartmann report a cyst lined with flat cells containing elongated nuclei, reminding them of endothelium. In certain places it seemed more like nucleated protoplasmic plaques than distinct cells. The lining was not continuous. On the contrary, Le'cene' has seen the interior of the cysts lined continuously with cuboidal cells. Papin has also observed flat and cuboidal epithelium. Simon says the epithelium is not constant but exists in the majority of cases.

The parenchyma near the cysts has shown various changes. Terrier remarks that to the naked eye the renal tissue looks normal but microscopically there are evidences of nephritis. The parenchyma is thickened next to the cyst wall, the juxtacystic tissue is inflammatory, and the walls of certain tubules show a slight degree of fatty infiltration. The kidney away from the cyst is normal. (Delkeskamp). According to

Englander, the tissue around the cyst is thickened, but presents no remarkable changes. The cyst wall has been described as continuing, without a clear line of demarcation, to the normal tissue. Most observers report the tubules near the cyst distorted; some compressed, others dilated, whose epithelium shows granular degeneration. The glomeruli present various changes from the normal to those seen in nephritis. The etiological foundation for the production of the cyst has been theoretical in most of the cases; the origin of the obstruction has not been determined.

Treatment.—The treatment of so-called simple or serous cysts of the kidney has varied with the times. In the early days of renal surgery, puncture was a method of attack; either alone or followed by injections into the cavity. This procedure was uncertain and not without risk. It was generally necessary to make repeated puncture, owing to the re-filling of the cyst and the process was trying to the patient and unsatisfactory to the surgeon. Touren in 1865 reported a case treated by puncture followed by caustic injections. Iodine has frequently been used as an injection into the cavity after the removal of the contents. With the method of puncture and injection, one runs the risk of having multilocular cysts as a result. Lejar's statistics of 7 patients treated by puncture gave 3 cures and 4 deaths. Three patients treated by puncture and injection, 3 deaths. In the light of renal surgery of to-day, such methods should only be employed in cases of very voluminous cysts to diminish their size so that the removal will be more easily executed.

Cystotomy was also an operation performed quite frequently in the days of yore. It was done either through the lumbar or transperitoneal routes. By the lumbar operation the cyst is exposed, opened, and emptied of its contents. The redundant wall is cut away, the edges then are fastened to the deep layer of lumbar fascia. The secreting surface of the cyst is destroyed by carbolic or nitric acid, and the cavity allowed to contract and granulate. The transperitoneal method is on the same principle, the cyst is opened, contents

removed, edges of the wall stitched to the abdominal parietes, cavity drained and allowed to contract. In some cases complete obliteration ensues.

The advantage of such methods are that they do not interfere with the remaining kidney tissue and are not accompanied by hemorrhage. The disadvantages, which have the predominance, are that the wound is slow in healing, is always liable to secondary infection, and the danger of fistula is great. Morris reports five cystotomies with three fistulæ. Simon reports three cystotomies, one cure, two deaths. Tuffier's statistics show eight cystotomies, six transperitoneal and two lumbar; three were followed by fistula and one required nephrectomy later.

For cysts of moderate size, the most satisfactory method is the one which has been utilized by Tuffier, Bardenheuer, Ricard, Recamier and Albarran, each in one case—namely, the excision of the cyst. In this manner most of the renal substance is preserved and the function of the kidney but little interfered with. In the description of their cases it is noted, as one would suppose, that the cysts would not shell but required dissection. Concerning this point, the cyst removed by the author differed, as it shelled out easily, required no cutting at all except in the region of the papilla, where it was cauterized from its attachment to the pelvis. Bardenheuer had to do a secondary nephrectomy on account of infection. Hemorrhage did not prove alarming in these cases, and it should be no more copious than that following an ordinary nephrotomy, provided one closes the kidney properly, following the removal of the cyst.

Partial nephrectomy, according to Morris, should be performed if the cyst is situated at one pole of the kidney and a considerable part of the renal parenchyma is spread out over the cyst wall, and if the large renal vessels can be left intact. This operation has held but little prestige and is seldom used.

Complete nephrectomy is applicable to very large cysts, which have destroyed most of the renal substance, and to

many cysts scattered in one kidney. Quenu in 1882 reported 7 nephrectomies, 5 cures and 2 deaths. Lejars in 1889, 16 nephrectomies, 9 cures, 7 deaths. Albarran, 7 nephrectomies, no deaths. Tuffier collected 24 nephrectomies for cysts, 13 cures and 11 deaths. A glance at the above illustrates a very high percentage of mortality following the operation. The statistics of Albarran are more in accordance with the reports of individual operators of recent date. The improvement is undoubtedly due to more refined technic and to a more thorough knowledge of the functional ability of the remaining kidney.

In conclusion, the author desires to delineate and emphasize a few features in his case which seem to be of particular interest in comparison with other cases of a somewhat similar nature that have been previously reported.

As has been the rule in most cases, the diagnosis of the kidney cyst was not made before operation. The diagnosis in this case was renal calculus. In examining the X-ray plates since our acquaintance with the condition, it is very easy to see upon which shadow, crescentic in outline, in the region of the renal pelvis, the diagnosis of stone was made. External to this there is a very faint shadow about the size of a half dollar, which was thought to be an artefact, but which is evidently the cyst wall. It is so faint that reproduction is impossible. The urinary findings at the first examination are easily explained by the fact that no urine was being obtained from the affected area, the papilla being completely obstructed. There was evidently a compensatory hypertrophy of the remaining renal parenchyma, explaining the normal renal function.

The pathological aspect of the case is very interesting in that the primary lesion, if not unique, is extremely rare, it being a dense papillary sclerosis with incrustation of calcium phosphate confined to one papilla, the other papillæ being, as far as could be determined in a normal state of preservation. The condition was responsible for the retrodilatation and cyst formation, a process which many authors consider impossible. The other interesting points are that the cyst was entirely con-

fined to the pyramid, there being no cortical substance composing its wall or immediately adjacent to it. The wall of the cyst was firm and dense, containing no remnants of tubules as far as could be determined, nor did it possess any epithelial or endothelial lining. This latter point has been argued by some as refuting the tubular origin of cysts, but it seems without sufficient ground, as one would scarcely expect an epithelial lining to be preserved in a cyst having such thick sclerotic walls with poor nourishment. There has undoubtedly been an epithelial degeneration. In the kidney adjacent to the wall one can trace various gradations of epithelium from tubular to flat, depending upon the size of the cyst space. There was but one large space found in the sections examined which possessed a cubical epithelial lining. This is illustrated in Figs. 5 and 6. The renal cortex, corresponding to the area drained by the diseased papilla, was not thinned out. On the contrary, it was slightly thicker than the remaining cortex; was quite dense and sclerotic, but contained no visible cysts.

The operative features of interest are that the method employed has been utilized, as far as can be determined, but five times previously—by Tuffier, Bardenheuer, Ricard, Recamier and Albarran; and that no trouble was experienced in shelling the cyst from its bed, as it was completely demarcated from the remaining kidney.

Finally, the author wishes to express his sincere thanks to Professor Opie for suggestions in the pathological preparation of this paper; to Professor Shaffer for the analysis of the stone; and to Dr. Downey L. Harris, bacteriologist of the city of St. Louis, for his excellent microphotographs.

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AN EXPERIMENTAL STUDY OF SEVERAL METHODS OF SUTURING THE KIDNEY.

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THE damage done to the kidney by operation was discussed in a former communication to the *ANNALS OF SURGERY* (vol. liii, p. 373), by the authors of this paper. The damage done by incision, and the damage done by subsequent suture, comprise two distinct types of trauma. In the first class are such lesions as result from the anæmia produced by the cutting of the blood-vessels by the knife. These lesions usually consist of small anæmic infarcts, the shape and size of the infarct depending upon the distribution of the severed vessels. The damage done by the suture is usually much more extensive and very much more erratic. This may range anywhere from the late destruction of the entire kidney to conditions in which there is only a very little new scar tissue. One of the unfortunate results from applying ligatures is the strangulation of small pieces of the kidney parenchyma, particularly in the pyramids. Such strangulated material may become calcified, and later on form a basis for a calcium phosphate stone (Fig. 1). This particular specimen was taken from an animal experiment in which the apex of a papilla was purposely strangulated by a circular suture. On killing the animal three months later, the condition found in the picture was shown. Beside the single large stone, there were found a great many smaller stones in the pelvis of a hydronephrotic kidney.

The infarcts resulting from a strangulation of tissue grad-

ually undergo cicatrization. Such scars naturally retract, and the original extensive lesion is reduced to a comparatively insignificant affair. However, much of the kidney parenchyma is destroyed by this process, and, while the compensatory hypertrophy may restore the initial volume of the kidney, much actual parenchyma is lost. The occasional finding of bone in these old scars is only of theoretical value. Inasmuch as the essential damage done by suture and by incision consists in the interference with the blood supply, it might be well to discuss the blood-vessels of the kidney before proceeding with a description of any technic.

The Renal Blood-vessels.—The kidney is plentifully supplied with blood by the renal artery, a large offset of the abdominal aorta. Previous to entering the kidney, each artery divides into four or five branches, which are distributed to its substance. At the hilum these branches lie between the renal vein and ureter, the vein being in front, the ureter behind. Each vessel gives off a small branch to the suprarenal capsules, the ureter, and the surrounding cellular tissue and muscles. It has been pointed out by Hyrtl (p. 679) that the renal artery gives off a branch which divides and supplies the dorsal portion of the kidney and a branch which divides and supplies the ventral portion of the kidney. Between these two vascular systems is a non-vascular zone, called by Bryon Robinson the "exsanguinated renal zone of Hyrtl." It "is one-half inch dorsal to the lateral longitudinal renal border."¹

This anatomical condition has been taken advantage of by Dr. E. K. Cullen, of Baltimore (*Surgery, Gynecology and Obstetrics*, vol. xiii, p. 365), in devising a method for opening the kidney. Dr. Cullen has established rules for locating the bloodless zone in the kidney, and advocates the use of a silver wire that tears its way through the kidney parenchyma. This procedure, theoretically beautiful, has not met with the good results in our hands that have been described. The objections

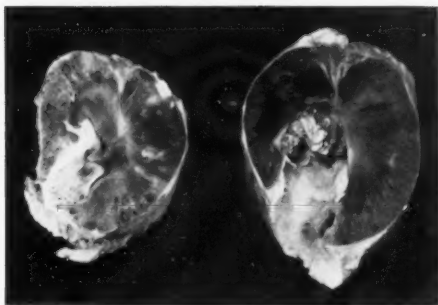
¹ From Gray's Anatomy, Da Costa, p. 1423, 1905.

to the silver wire method of opening the kidney are as follows: (1) difficulty in locating the bloodless zone of the kidney; (2) danger from hemorrhage in that some aberrant vessels often cross the kidney in a very irregular manner; (3) that the method necessitates the cutting of a number of collecting tubules and other kidney structures; (4) that the wire traumatizes and is difficult to control.

We have done a considerable number of operations with the knife, both disregarding entirely the bloodless zone and observing the bloodless zone, and an equal number with the wire in the bloodless zone. After these operations the animals were killed, and the amount of damage done to the kidney by these various procedures compared. In establishing the extent of damage done to the kidney, the entire structure was cut into sections approximately 1 cm. in thickness. These sections were photographed, and accurate measurements of the surface area of each infarct were made. When all of these surfaces had been measured, an average was taken. These figures were divided by a divisor obtained by dividing the size of the kidney under consideration, by a figure taken as a standard size for the kidney. Frequently as much variation occurred in the size of the infarcts with one method as with another. With the wire method sometimes the infarcts were very irregular (Figs. 2, 3, and 4). In one instance where the animal was kept for 90 days after operation, nearly one-fifth of the kidney had suffered destruction (Fig. 5.)

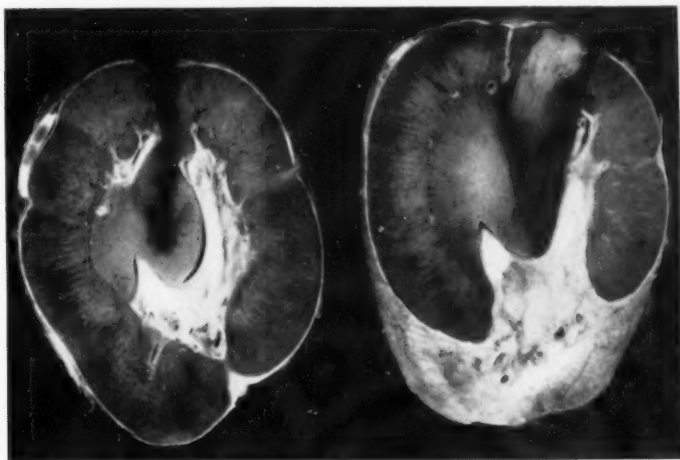
The tubules do not run parallel to the bloodless zone; therefore, in following this direction of incision, tubules are cut across. This is further accentuated with the wire, for the reason that it is not under perfect control and may traumatize tissues for a considerable distance. While in the process of healing, patent tubules may result by a growth of epithelium over the scar tissue, it is more frequently found that in animals where the silver wire method had been used, there occurred an atresia of the tubules due to compression of scar tissue, with the consequent result that may be expected

FIG. 1.



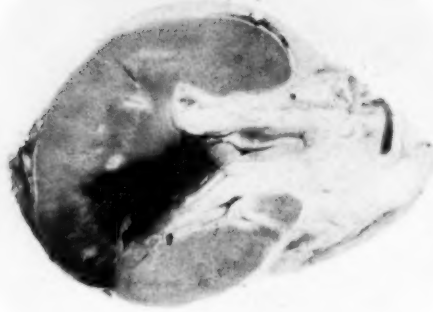
Contracted kidneys. Pelvis full of calcium phosphate stones. Stones are due to calcification of strangulated kidney substance—one of the dangers of mattress sutures.

FIG. 2.



Kidney split with silver wire in bloodless zone—shows variability in size of infarcts. (Three days.)

FIG. 3.



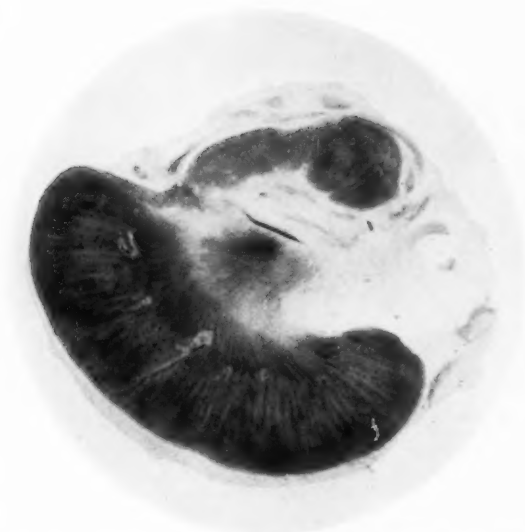
Kidney split with silver wire in bloodless zone. (Five days.)

FIG. 4.



Kidney split with silver wire in bloodless zone. (Five days.)

FIG. 5.



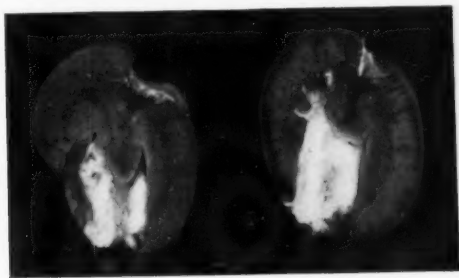
Kidney split with silver wire in bloodless zone. Loss of large amount of kidney parenchyma. (Three months.)

FIG. 6.

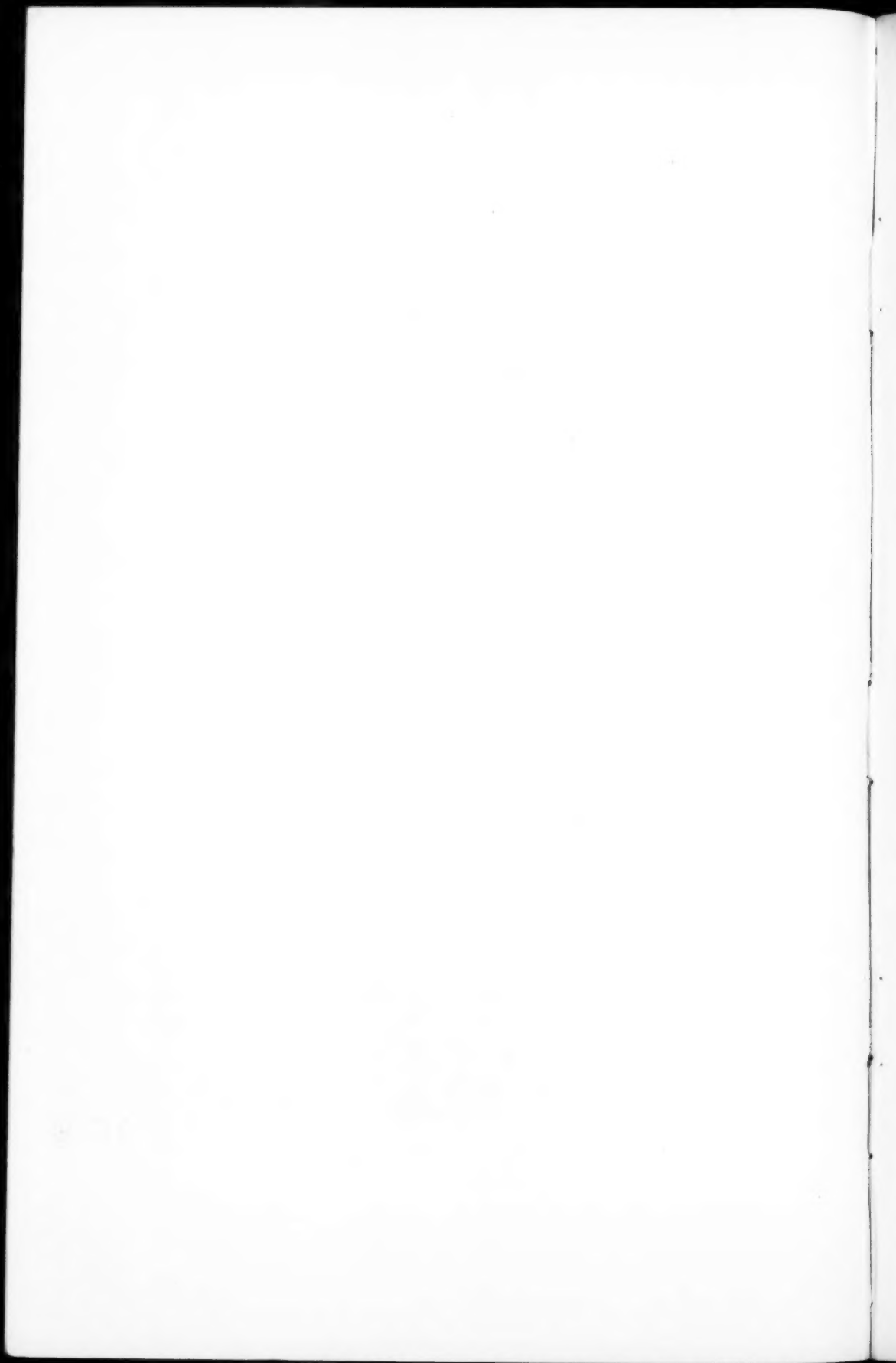


Kidney split in mid-plane. Sutured blood-vessel—silk. Hemorrhage controlled by soft-jawed forceps. (Ten days.)

FIG. 7.



Kidney sutured. Method III. Some loss of kidney substance, but note that damage is superficial. (Six months after operation.)



to follow an atresia of these structures. For these reasons other methods of opening the kidney were tried, and after numerous experiments, the following procedure was found to accomplish the purpose with the very smallest degree of hemorrhage and comparatively little post-operative destruction of the tissues.

First, a Carrel soft-jawed forceps was applied to the renal vessels. This instrument had sufficient elasticity to prevent the ingress of blood to the kidney, without excessive bite enough to cause any damage to the endothelium of the vessels. Then the kidney was opened with a sharp knife, care being exercised to avoid the poles of the kidney. It was invariably found that after the incision had been made, there occurred very slight gushing of blood, amounting, in my cases, to but a few drops and never over a drachm. After the necessary exploration had been done, the kidney parenchyma was approximated by through-and-through sutures of very fine silk. These sutures were applied according to Method III described in our previous communication. Great care was exercised in tying these sutures so as to avoid any possibility of strangulation. Then the clamps were removed, and the kidney allowed to drop back. As a result of this procedure, even when the cut surfaces of the kidney had been very lightly approximated by the sutures, there occurred no hemorrhage whatever.

One kidney split and sutured in this way showed at the end of ten days a very slight infarct (Fig. 6), scarcely greater than those that come from a simple incision of the kidney without suture. In some of the animals that had been allowed to live for several months, at the end of this time there were found to be only slight differences in the weight and in size of the epithelial structures of the operated and unoperated kidneys, showing that comparatively little damage had been done. In some of these kidneys small areas of parenchyma had been lost, but apparently without the serious scars and contractures that follow some of the older methods of suture.

A TABLE SHOWING RESULTS FROM VARIOUS METHODS OF SUTURE.—THIS TABLE IS INTRODUCED TO SHOW THE AMOUNT OF DAMAGE THAT MAY RESULT FROM SUTURE. METHOD II REFERS TO MATTRESS SUTURES. METHOD III REFERS TO THROUGH-AND-THROUGH SUTURES. WIRE METHOD REFERS TO SILVER WIRE METHOD. METHOD IV REFERS TO SERREFINE CLAMP METHOD WITH FINE THROUGH-AND-THROUGH SUTURE.

A. E. No.	Time after operation.	Method.	Result.
11-19....	17 days	II	Death. Uræmia, acute degeneration.
11-18....	3 months	II	Almost complete cicatricial destruction of kidney.
11-34....	4½ months	II	Calculi. Death from uræmia. Nitrogen excretion abnormal.
11-1	3 months	II	Stones obstructing ureter.
11-17....	6 months	III	Kidneys weighed 6.4 and 6.1 Gm. Nitrogen excretion normal. Some cicatricial loss of parenchyma. (Fig. 7.)
11-74....	30 days	Wire	Variable infarct. (See Fig. 2.)
11-80....	5 days	Wire	Variable infarct. (See Fig. 4.)
12-25....	3 months	Wire	Loss of one-fifth of kidney. One-tenth of parenchyma damaged.
12-113...	1 day	IV	Thin infarct.
12-128...	7 days	IV	Thin infarct.
12-76....	10 days	IV	Mere line. (Fig. 6.)
12-129...	3 months	IV	Weight same. Slight loss of parenchyma, due to excessive tension.

To the objections that the temporary cutting off of the blood supply of the kidney might result in some damage to the kidney, a series of experiments were undertaken to show what changes occurred in a kidney as a result of a series of atresias of the vessels for various periods of time. In this series of experiments, the kidney was loosened from the peritoneal covering, a soft-jawed serrefine clamp applied to the vessels, which was allowed to remain there for either one or two hours, as the case might be. In the one-hour series, the animals were killed at various periods of time subsequent to the procedure, and the kidneys were studied by making sections and staining them by the following methods: (1) Zenker and hæmatoxylin; (2) Bell's acid chromic mixture, and Soudan III; (3) formalin and hæmatoxylin.

As a result of this work, the only lesions recognized were as follows:

A TABLE SHOWING CHANGES IN THE KIDNEY SUBSEQUENT TO ATRESIA OF THE RENAL VESSELS FOR VARIOUS PERIODS OF TIME.

A. E. No.	Time of atresia.	Time after operation.	Lesion.
106.....	1 hour	3 days	Degenerative lesions; desquamation of epithelium; basal fat; fatty metamorphosis.
109.....	1 hour	3 days	Exudate in tubules; basal fat and fatty casts.
53.....	1 hour	5 days	Indeterminate.
49.....	1 hour	6 days	No difference in kidneys.
50.....	1 hour	6 days	No difference in kidneys.
52.....	1 hour	3 months	No difference in kidneys.
63.....	1 hour	3 months	No difference in kidneys; except compensatory hypertrophy on account of removal of other kidney. Nitrogen output normal.
12-105...	2 hours	3 days	Fatty metamorphosis; basal fat; degeneration and desquamation.
12-110...	2 hours	6 days	Many casts. Spontaneous nephritis.
12-70 ...	2 hours	6 days	Basal fat; exudate in tubules; degeneration of tubules.
12-80 ...	2 hours	34 days	Small infarct.
12-68 ...	2 hours	90 days	Normal.
12-69 ...	2 hours	90 days	Normal. Compensatory hypertrophy from removal of other kidney. Nitrogen output normal.

In the one-hour series there was usually found after a convalescence of three days degenerative lesions, involving the epithelium only, desquamation of epithelium of tubules, and more or less fatty change; sometimes basal fat. As the accompanying table will show, animals that were killed six days after the atresia did not manifest these lesions. Therefore the damage must be quickly repaired. In the two-hour series the fat changes were much more marked than in the one-hour series, and the degenerative changes more prominent. These changes were also transitory, but of slightly longer duration.

As no changes were found in either the one-hour series or the two-hour series in animals killed after a longer interval of time, it was assumed that the slight degenerative lesions and fat metamorphosis were quickly recovered from, probably by a process of epithelial desquamation and regeneration. That a kidney can functionate after one-hour atresia to sufficiently maintain life is shown in A.E. 12-63, and often after two hours' atresia in A.E. 12-69.

A TABLE SHOWING THE DAILY AMOUNT OF URINE, THE NITROGEN OUTPUT, THE NITROGEN INTAKE, AND THE WEIGHT OF AN ANIMAL IN WHICH THE RIGHT KIDNEY HAD BEEN REMOVED AND THE LEFT KIDNEY HAD BEEN SUBJECTED TO DAMAGE BY CLAMPING THE RENAL VESSELS FOR ONE HOUR. (A. E. 12-63.)

No.	Date 1912.	N. per c.c.	Quantity.	Total N.	N. I.	Carrots. Grammes.	Weight. Grammes.
9....	5-24	0.003064	335	1.026		390	2250
11....	5-25	.00220	190	.418		125	
15....	5-26	.00276	270	.745		133	Albumin +

AVERAGE:

First three days after operation.....0.729

16....	5-29	0.005025	340	1.708		350	
17....	5-30	.003037	350	1.062		500	

AVERAGE:

Four and five days after operation1.370

Albumin +

18....	8-13	.001905	360	0.685	1.020	500	2610
20....	8-14	.001684	365	.624	1.020	500	
22....	8-15	.002291	355	.813	.979	480	
24....	8-16	.001910	577	1.102	1.020	500	
26....	8-17	.002428	225	.545	.969	475	
28....	8-18	.002153	365	.784	.858	420	
29....	8-19	.002319	365	.846	.898	440	
31....	8-20	.002540	355	.902	.776	380	
32....	8-21	.001794	335	.601	.707	347 ²	2538
35....	8-22	.003589	213	.764	.846	415	

AVERAGE:

Three months after operation0.711

A TABLE SHOWING THE DAILY AMOUNT OF URINE, THE NITROGEN OUTPUT, THE NITROGEN INTAKE AND THE WEIGHT OF AN ANIMAL IN WHICH THE RIGHT KIDNEY HAD BEEN REMOVED AND THE LEFT KIDNEY HAD BEEN SUBJECTED TO DAMAGE BY CLAMPING THE RENAL VESSELS FOR TWO HOURS. (A. E. 12-69.)

No.	Date 1912.	N. per c.c.	Quantity.	Total N.	N. I.	Carrots. Grammes.	Weight. Grammes.
19....	8-14	0.002761	360	0.9939	0.918	450	1995
21....	8-15	.002108	345	.7272	.918	450	
23....	8-16	.00220	300	.6600	.918	450	
25....	8-17	.002484	225	.5589	.867	425	
27....	8-18	.002484	185	.4595	.795	390	
30....	8-19	.001910	235	.4488	.816	400	
32....	8-20	.001794	295	.529	.795	390	
34....	8-21	.001910	330	.630	.836	410	
36....	8-22	.002346	265	.621	.826	405	
37....	8-23	.00220	325	.715	.903	345	1995

AVERAGE:

Three months after operation.....0.63433 .8392

Résumé.—Mattress sutures cause extensive destruction of kidney substance.

Silver wire with mattress sutures cause a variable amount of damage.

Simple incision with over-and-over sutures does not produce serious lesions.

The serrefine method produces slight lesions. While this is not free from infarction, the only legacy left is a slight loss of parenchyma without other complication.

I am indebted to Dr. E. T. Bell for his method of staining fat.

"DUMB-BELL" KIDNEY.*

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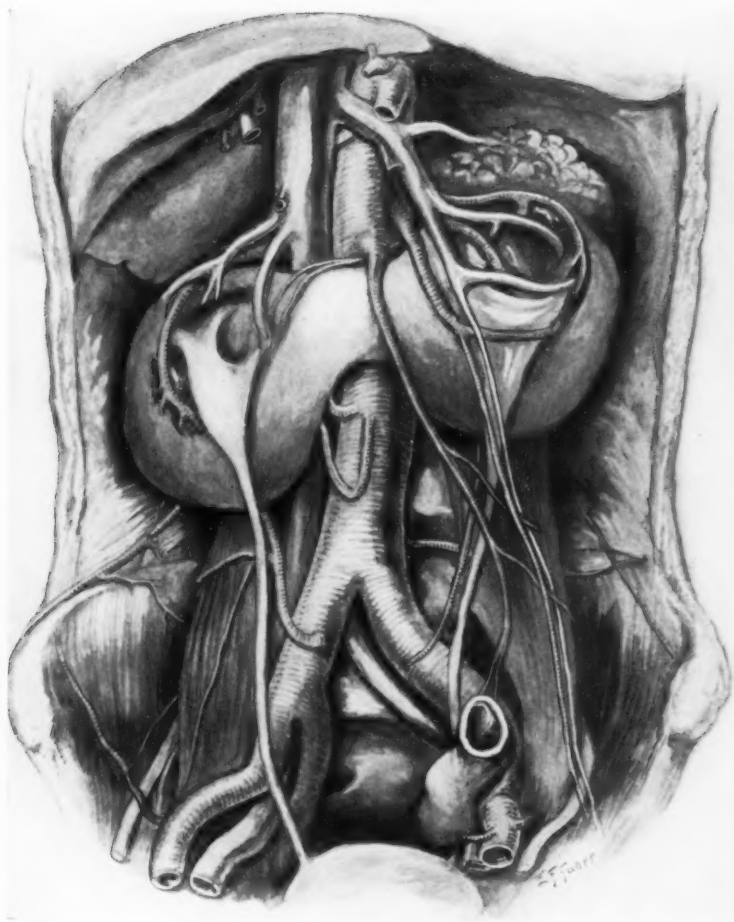
AN unusual difficulty which might be met in renal surgery on the living patient is illustrated by a recent experience in attempting nephrectomy on a cadaver in the Laboratory of Anatomy of the University of Pennsylvania. The body was that of a male aged seventy-one years, whose length of life and whose clinical history would preclude any suggestion of inadequacy of renal function. The specimen was found while attempting to remove the kidney through a lumbar incision, which we were unable to do. After complete exposure of the kidney through the left loin, the cause of the impossibility of delivery was found to be due to a congenital abnormality, the main feature of which was a continuity of the renal tissue of one side with that of the other across the spinal column. This could be determined readily by means of a finger passed along the dorsal surface of the renal tissue. In freeing the kidney a large renal artery from the left common iliac to the left lower pole was torn away in the supposition that we were dealing with a perirenal adhesion, an unlikely mistake in the living, in the presence of pulsation.

The specimen consists of two lateral masses of kidney substance with a connecting bar of the same tissue. These masses are flattened from before backward and with the intervening tissue suggest, on anterior view, the form of a dumb-bell (Fig. 1).

Right Half.—This portion is, like its fellow, irregularly rounded in outline but of somewhat greater transverse diameter. The posterior surface is made up entirely of smooth renal tissue, while the anterior surface is hollowed out in its central portion to form what is really the

* Read before the Philadelphia Academy of Surgery, February 3, 1913.

FIG. 1.



Dumb-bell kidney.

1000

1700

hilum. The ring of kidney substance surrounding the hilum varies from one-half to three-quarters of an inch in width. Mesially it joins with the isthmus over the vena cava inferior, the isthmus being two inches in diameter at this point.

Measurements.—This portion is placed obliquely, pointing downward and inward, and in this, its greatest transverse diameter, it measures three and one-half inches. The greatest vertical diameter is along the outer edge where it measures three and one-half inches but in passing towards the mid-line it contracts to two and one-half inches, its minimum vertical diameter. The thickness varies from an inch at the outer and upper border to a very narrow edge at the lower inner aspect. The hilum measures two and one-half by one and one-half inches, is regular in outline, and is formed at the expense of the central portion of the renal tissue, a thin plate of which, however, persists posteriorly.

Relations.—The upper pole is on a level with the lower border of the first lumbar vertebra, while the lower border is on a line with the lower border of the third.

Left Half.—This is more circular in outline than the right and is approximately three and one-half inches in all diameters. Areas of variation in thickness are seen similar to those in the right portion. The hilum is of the same depth as on the right and measures two and one-quarter inches in all directions.

Relations.—This portion is higher than the right, its upper and lower borders being opposite the upper borders of the first and third lumbar vertebræ respectively.

The Isthmus.—This is approximately quadrilateral and expands slightly at either extremity to fuse with the annular rims surrounding the hila. The upper and lower edges are sharp and thicken gradually as they fuse with the lateral masses. It arches over the great vessels, describing an angle the apex of which is over the aorta. Tracing the isthmus from left to right we find it passing downward and forward to the anterior surface of the aorta and from this point the right half passes horizontally and backward, an arrangement explained by the higher position of the left kidney.

Measurements.—Transverse, two inches; vertical, one inch; thickness, one-eighth inch.

Relations.—The isthmus crosses the mid-line over the intervertebral disc between the third and fourth lumbar vertebræ, joining the right kidney at the right margin of the inferior cava and the left kidney at a point one-half inch distant from the mid-line. The highest point on the right half is one-quarter inch lower than the highest point on the left half.

The Ureters.—The pelvis of each ureter is dilated to three times the normal size. This, together with a dilated bladder, which presents in the right lateral wall a diverticulum the size of a hen's egg, is explained by the enlarged prostate gland present, and has together with the remaining parts of the urogenital system, no relationship with the embryological defects of the kidneys and upper ureters. From the common iliac arteries, the ureters pass upward, on both sides crossing from within

outward a renal artery from the common iliac. The uretero-pelvic junction is at the lower margin of the kidney substance, and the pelves soon divide into calices, six on the right and four on the left side, one on each side apparently draining the isthmus. The greatest width of the right pelvis is two inches and that of the left, one and one-half inches. The pelves and ureters are placed anterior to the kidney tissue and for the most part below the renal vessels.

Blood Vessels.—There will be noted a deflection of the aorta and the vena cava to the right and an apparent difference in length and topography of the iliac vessels; these are artefacts due to the injection of the cadaver. In consequence the right common iliac artery has a more vertical and apparently a shorter course than its fellow.

The branches of the aorta present many anomalies. They arise, from above downward, in order as follows: (1) Inferior phrenic artery; (2) coeliac axis; (3) superior mesenteric; (4) right renal; one-half inch below the preceding; (5) left renal; (6) left spermatic; probably a renal giving a spermatic branch; (7) inferior mesenteric; (8) first lumbar; (9) second lumbar; (10) renal, from the anterior surface of the aorta, one and one-half inches from the bifurcation and just above another renal; (11) renal, just below the preceding; (12) third lumbar; (13) median sacral.

There will be noted as being absent from this list the suprarenal, right spermatic and fourth lumbar arteries. The suprarenals come from the renals, the right spermatic from a renal branch given off from the right common iliac, and the fourth lumbar from the common iliacs. With the exception of the right spermatic nature has compensated for the absence of the suprarenals and fourth lumbar by the addition of two anomalous renals, thus establishing the normal quota of branches derived from the abdominal aorta.

Renal Arteries.—Seven arteries are given to this dumb-bell kidney. Four of these come from the aorta, one from each common iliac artery, and one from the left spermatic. This latter is probably as explained above, a renal artery giving origin to the spermatic.

Considering the renal arteries from above downward, the first one arises from the right antero-lateral surface of the aorta, one-half inch below the point of origin of the superior mesenteric, passes behind the vena cava, and gives off the right suprarenal and a slender branch to the upper pole of the right kidney. Then, crossing the upper portion of the renal tissue to reach the hilum, it sweeps around the outer edge of the latter, half encircling it, and finally turns directly transversely to enter the substance of the kidney at its centre. It gives eight branches to the kidney.

The second renal arises from the aorta one inch below the preceding vessel and at a corresponding point, and has a similar course. In addition to the four branches which it gives directly to the kidney, a large branch arises one inch from its origin. This soon divides into a mesial and a lateral branch. The mesial branch gives off two slender twigs which course along the upper margin of the isthmus to enter the right hilum, a third to the left end of the isthmus and a large terminal to the mesial

border of the left hilum. The lateral branch enters the hilum near its point of origin.

The third renal (left spermatic) arises just below the preceding, passes downward and outward, crosses the renal pelvis and enters the hilum at its infero-lateral angle. The left spermatic artery arises from this vessel at its mid-point.

A fourth renal arises from the anterior surface of the aorta two inches above its bifurcation and, passing upward and to the right, enters the middle of the posterior surface of the right kidney at its junction with the isthmus.

A fifth aortic renal arises just below the preceding vessel and runs downward for a distance of one inch, being adherent to the aortic wall. It then turns at an acute angle and ascends to the margin of the right kidney at its infero-mesial aspect.

A large renal artery is given from each common iliac at the mid-point of its internal surface. These vessels curve around the anterior surface and are directed upward and outward. The right passes behind the ureter, to which it gives two branches, and after giving origin to the right spermatic, enters the lower margin of the kidney. The left gives off one ureteral branch and then enters the left kidney at the mid-point of its lower margin.

Veins.—Three veins emerge from the right hilum. Two, with a communicating branch from the upper outer aspect, pass upward and inward to enter the right margin of the vena cava. A third emerges from the lower internal margin of the hilum and passes upward to the anterior surface of cava, opposite the first lumbar vertebra, the others being one-half inch above this level. The veins are, anterior to the arteries.

The left renal veins number three, one emerging from the upper, one from the lower and a third from the lateral edge of the hilum, the latter receiving the left spermatic vein. They pass upward and inward and unite in a single trunk which joins with the splenic vein to enter the cava on a level with the highest renal on the right side. The portal vein is made, therefore, entirely of the superior mesenteric vein. There is no abnormality of relationship of the structures entering the portal fissure. The physiological importance of hepatic influence on the blood of the splenic vein is a question for consideration in the presence of this rare vascular anomaly.

Explanation.—The primitive kidney is a pelvic organ derived from a portion of the paravertebral mesoblastic tissue of the pelvic wall, the renal blastema, and from the branching subdivisions of the expanded ends of the primitive ureter, which contribute that portion of the uriniferous tubular system represented by the straight collecting tubules. Each organ is formed independently, and possibly as a result of changes in the line of curvature of the caudal extremity of the spinal column, ascends until by the end of the third month of fetal

life has reached its adult position. Fusion of the renal masses, as in this case, would cause retardation in the ascent, probably as a result of the development of the sacral promontory, which would offer obstruction to the isthmus in the mid-line and prevent the normal passage upward of the lateral masses along the ilio-lumbar grooves. Nature vascularizes the renal tissue from adjacent vessels and this would contribute to the difficulty of ascent, as illustrated by the markedly angular course of those renal arteries in our specimen which are derived from the anterior surface of the aorta near its bifurcation. It is our conception that the dumb-bell type illustrates fusion of the lower poles of the primitive kidneys which in ascending were rotated as it were on their backs and transversely, as a direct result of retardation in ascent of the mid-portion or isthmus.

Review of Literature.—The horseshoe kidney, a rare variety of which we present and describe as a “dumb-bell” kidney, is the most common type of a single mass of misplaced kidney tissue of abnormal form. The bases of Morris’ convenient classification are abnormalities in number, position and form, and our specimen deviates from the normal in all three of these essentials. We will confine our remarks to a consideration of numerical congenital anomalies, at the same time calling attention to the almost constant association therewith of morphologic and topographic defects.

The numerical congenital abnormalities may be divided into three groups: (A) Absence of both kidneys; (B) supernumerary kidneys; (C) single kidney.

(A) The absence of both kidneys is not merely a “teratological curiosity of the first months of embryonic life” as held by Guiteras,¹ for the vital functions can go on in both intrauterine and extrauterine life in the complete absence of renal tissue.

Ballowitz² and Mayer³ report the congenital absence of the kidneys in a large number of living and still-born children. The extraordinary case of Moulon⁴ of a girl, who reached the age of fourteen and in whom post-mortem examination proved the entire absence of renal tissue, would indicate the

possibility of life in the total absence of these "vital organs." In this case the liver had apparently vicariously assumed the kidney function, as a patulous umbilical vein discharged a fluid with chemical characteristics resembling urine. That the liver and intestines can assume the renal function for a time at least is undoubted, as in the case reported by Seth Gordon,⁵ whose patient lived for twenty-seven days after the removal of a single kidney. Vieusseux,⁶ of Geneva, reports a case of total suppression of urine without uræmia for a period of seventeen months, followed by a re-establishment of renal function and the survival of the patient.

The rarity of these cases is so great that but little practical importance can be attached to them.

(B) Supernumerary kidneys. This condition is even more rare than is complete absence of renal tissue.

Isaya⁷ reports the case of a female aged twenty-seven, who had suffered with recurring attacks of abdominal pain since childhood. Operation showed a movable tumor present in the abdomen to be a supernumerary kidney, the recurring pains being caused by twists of its ureter. This author collected fifteen cases, ten of which were found post mortem, the others at operation. Cobb and Giddings⁸ found only seven cases of true supernumerary kidney in all the literature and add a case of cyst-adenoma of an accessory organ. Oleson⁹ found two adventitious kidneys in one case, one at either superior pole of a horse-shoe kidney. Cheyne,¹⁰ and more recently, A. F. Dixon,¹¹ found supernumerary kidneys at the pelvic brim. These cases usually become of clinical significance as a result of undue mobility.

(C) Single kidney. The body may contain one mass of renal tissue as a result of (a) Congenital absence or rudimentary development of one kidney—unsymmetrical kidney; (b) atrophy of one kidney, the result of disease; (c) congenital fusion of the kidneys—solitary kidney; (d) surgical removal of one kidney.

(a) Congenital absence of one kidney or extreme types of unilateral rudimentary development are rare abnormalities.

Anders¹² collected 286 cases from the literature up to March 1912. This author, from a review of 92,690 autopsies, estimates the frequency of this defect as one in 1817 cases, and quotes the estimate of Dennis¹³ of one in 2650 cases.

In our own studies we have found three instances of the condition in a series of 2479 autopsy reports kindly placed at our disposal by Dr. Allen J. Smith. The complete list of the congenital defects of the kidneys found in this series is given in the following statistics (total cases, 2479):

a. Unsymmetrical kidney—3 cases:

Infant three days old. Left kidney unusually large and malformed; right kidney absent; patulous foramen ovale and ductus arteriosus.

Young girl. Right kidney and ureter absent; left kidney twice the normal size; congenital recto-vaginal fistula.

Male, aged sixty-three. Right kidney, ureter and vessels absent.

Congenital misplacement	3
Movable kidney	11
Type not stated	8

b. Abnormalities in shape:

Horse-shoe	3
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Male, aged fifty. Pelvis arising from posterior surface of right kidney; both kidneys nodular.

Male, aged eighty-four. Slight irregularity in shape.

Male, aged sixty-three. Right kidney low in position and hilum pointing anteriorly.

Persistent fetal lobulation	10
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Morris¹⁴ estimates the frequency of unsymmetrical kidney from the records of 15,904 autopsies and the collected statistics of several authors as one in 2400 cases. Ransohoff¹⁵ collected the statistics of eleven operations on unsymmetrical kidneys, four nephrotomies and seven nephrectomies. A list of 226 cases is given by Craven Moore¹⁶ from collected autopsy statistics.

Laparotomy for pelvic tumor in a female aged seventeen

years, recently performed by Cullen¹⁷ showed absence of the uterus, the ovaries in the inguinal canals, absence of the left kidney and a large right kidney in the pelvis simulating a neoplasm. Guiteras had the unusual experience of meeting with three cases at operation in a small hospital service within a period of ten months. Seth Gordon has met with two cases at the operating table and it is of interest to recall that Paasler performed the first nephrectomy on a single kidney misplaced in the pelvis in the belief that he was dealing with an ovarian mass.

The kidney when lacking is usually absent on the left side and the remaining organ, while often in its normal position, may be found in any part of the abdomen or pelvis. They are usually functionally sufficient, as evidenced by the seventeen cases reported by Newman¹⁸ all of whom lived beyond the age of sixty. This is explained by a true hyperplasia of the renal tissue. The ureter and blood vessels of a single unilateral kidney are normal in the majority of cases but may show many variations.

Rudimentary development of one kidney is of the same practical importance as unsymmetrical kidney and of the same comparative frequency.

(b) The very much more practical question of unsymmetrical kidney resulting from pathological destruction to its fellow is of too wide scope to be discussed in this paper.

(c) Congenital fusion of the kidneys. Solitary kidney. This abnormality finds its most frequent expression in the horse-shoe kidney, the simplest type, which Rokitansky¹⁹ calls the "lowest degree of fusion." On the other hand the kidneys may be fused into a discoidal mass lying usually in the median line, misplaced downwards, and often provided with a double pelvis and two ureters. This represents the "highest degree of fusion," and between these extremes are grouped the various intermediate forms. These morphologic variations are best understood if we recall Epstein's conception of their formation as the result of "fusion of the two kidneys at single points." It is impractical to satisfactorily classify the

various grotesque forms described by Brocsike,²⁰ Vaughn,²¹ Botez,²² and others.

The horse-shoe kidney occurs once in a thousand cases, as Morris estimated from 18,244 autopsy records from four London hospitals. J. E. Thompson²³ quotes Both who found five examples of the anomaly in 1630 autopsies. We found three such kidneys recorded in 2479 autopsies.

Associated Congenital Anomalies.—Congenital defects of other structures and organs are frequently found in association with solitary and unsymmetrical kidneys, especially the latter. The organs derived from the Wolffian and Müllerian systems are likely to be malformed or absent, usually on the side of the renal defect. Associated congenital defects of the external genitalia or of the cloacal orifice are frequently found. Persistence of the ductus Botalli, foramen ovale and ductus arteriosus have been reported. Craven Moore estimates the frequency of association of unsymmetrical kidney with defective development of the genital system as thirty-three per cent. Of 61 cases of unsymmetrical kidney collected by Anders, 21 had other congenital defects, in the majority of cases involving the genital organs. Since the ureter is developed as an out-growth from the Wolffian duct, faulty development of the latter may be primary and thereby explain the association of urinary and genital defects. In the female, however, the urinary defect is no doubt primary, since the Müllerian ducts are not fully formed until the kidney is well developed and has ascended into the loin space; but having a common mesoblastic origin defects in the renal system would likely be associated with defects in structures derived from the genital cord. The practical importance of this association can be most forcibly expressed by reference to Moore's case cited above.

Clinical Importance.—The malformed kidney as a rule gives rise to no clinical symptoms unless complicated or through pressure as the result of misplacement. Any disease to which the normal kidney is subject may affect the malformed organ, but hydronephrosis and its frequent sequel,

pyonephrosis, are the most frequent complications. Pressure of anomalous vessels on the ureter, as Wm. J. Mayo²⁴ has shown, is the cause in the majority of cases. Rovsing²⁵ has demonstrated that pain across the abdomen from one renal region to the other, relieved by rest, increased by exertion, especially hyperextension of the spine, in the presence of an abdominal tumor in the mid-line, is suggestive of horse-shoe kidney, although tuberculous mesenteric lymph nodes may give the same symptoms. This author divided the isthmus of a horse-shoe kidney transperitoneally with relief of all symptoms. Mackenzie operated for pelvic tumor and found a large ectopic horse-shoe kidney. Papin and Christian²⁶ found at autopsy hydronephrosis in fifteen horse-shoe kidneys, and note that patients have been operated on for this condition by Albarran,²⁷ Israel,²⁷ and others. Thompson collected six cases of hydronephrosis, six cases of calculus, two of which had pyonephrosis, one case of pyonephrosis without calculus and one case of sarcoma. He successfully performed heminephrectomy for pyonephrosis in the left half of a fused kidney. Eisendrath²⁸ and Deaver²⁹ did laparotomies in the belief that they were dealing with inflammatory masses of appendiceal origin and found hydronephrotic horse-shoe kidneys. Bockenheimer³⁰ successfully removed a cystic tumor and Harris³¹ divided the isthmus and removed the left half for tuberculous infection. Similar cases have been reported by Sutherland³² and Edington.³² Morris illustrates calculi impacted in each ureter of a horse-shoe kidney. Of twelve cases of unsymmetrical kidney found in the literature by Nessler, nine died of stone in the pelvis or in the ureter. A. D. Whiting³³ recently had a case of anuria from calculus obstruction of the ureter of a single kidney. Polk's case of nephrectomy of a single kidney for the relief of ovarian pressure pain illustrates the pelvic pressure symptoms which may arise from this condition. Obstructed labor has been caused in a number of instances.

Manley³⁴ and Gould report carcinoma, and Gordon sarcoma in unsymmetrical kidneys. The modern methods of

kidney diagnosis furnish pre-operative evidence of the futility of operative treatment in these fortunately rare cases.

Important steps in the recent progress of the surgery of the horse-shoe kidney are the division of anomalous blood vessels causing ureteric obstruction, division of the isthmus to relieve pressure symptoms, uretero-pelvic anastomosis, plastic operations on the renal pelvis for hydronephrosis and heminephrectomy by the transperitoneal route.

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TRAUMATIC HYDRONEPHROSIS.

WITH REPORT OF A CASE.

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THE part played by traumatism in the etiology of hydronephrosis for a long time remained obscure. Although reports of cystic kidneys with a preceding traumatic history were relatively common, especially in the eighties of the last century, nevertheless, for the most part, they were not convincing. The accounts were fragmentary, the histories missing, the autopsy and operative findings obscure or lacking.

Wagner, in 1894, first established the significance of traumatism in the causation of hydronephrosis by his continuous observation and exact account of a case. At this time he was able to collect from the literature ten authentic cases of this condition. To this he later added three more. Wildholz, in 1910, reported a case which he had observed, and contributed a thorough critical review of all the cases in the literature.

Legueu distinguishes between three groups of cystic kidneys with which traumatism is associated:

1. *True Traumatic Hydronephrosis*.—This is a dilatation of the kidney pelvis at the expense of the kidney itself, and presupposes an obstruction, more or less complete, of the ureter. In other words, it has all the physical characteristics of an ordinary hydronephrosis, but owes its origin to the result of some traumatism.

2. *Pseudotraumatic Hydronephrosis*.—This is really a perinephrosis with extravasation of urine, and possibly blood, into the surrounding tissues. In such cases, a well defined sac often develops. Especially is this the case in young individuals.

3. *Ruptured Hydronephrosis*.—That is, of an ordinary pre-existing hydronephrosis, the rupture being due to trauma.

The origin of true traumatic hydronephrosis may be a variable one. In the first place, traumatic injuries to the ureter which complicate the renal injury are of the utmost importance. They are invariably situated high up, near the origin of the ureter. The walls of the ureter may be contused, and lacerated, or they may be ruptured, or even completely severed. In any event, the outcome is a cicatricial stenosis or occlusion at the point of injury. Wagner believes that a perirenal bloody extravasate, due to the renal injury and to the traumatism of the surrounding tissues, may lead to compression and total occlusion of the ureter, while the ureter itself remains uninjured. Likewise some of the blood may clot and become organized, this, in turn, causing torsion and stricture of the ureteral wall.

Another cause of true traumatic hydronephrosis commonly accepted as correct, is that of a blood clot in the ureter, following an injury to the kidney. Küster, while not denying that a clot in the ureter may lead to a temporary dilatation of the renal pelvis, with retention of urine and blood, is still unwilling to believe that this can be permanent in the case of an uninjured ureter. The increasing pressure above would necessarily distend the ureter so that the arrested urine would find its way alongside the clot. Thus the frequent repetition of this process would sooner or later result in detachment and washing away of the clot. That this is true, has been proven by numerous clinical experiences, and contrary observations are very scanty, and in no case beyond criticism. The truth of this assertion is borne out by the case of Kroner, where a blood clot was found in the ureter at operation (nephrotomy) and the ureter soon regained its patency. Also in Wagner's case, it is probable that the temporary obstruction was due to a clot in the ureter, for there was initial hæmaturia, and the ureter subsequently became patent, following nephrotomy. If, however, the ureteral wall be injured at the site of the clot within the ureter, it is believable that organization may well take place.

Aside from the foregoing primary causes of true traumatic

hydronephrosis, there are still others, secondary ones. For example: a single traumatism may lead to floating kidney, and this in turn to obstruction of the ureter and then to hydronephrosis; and again, a blow over a calculous kidney may dislodge a small stone, with subsequent impaction in the ureter, resulting in a true traumatic hydronephrosis (Parker's case).

It is remarkable that of the few authentic cases of true traumatic hydronephrosis on record, less than a score in all, that two of these, and a third probably, should have occurred in individuals with solitary or horseshoe kidneys. However, it is not hard to conceive that such kidneys easily lend themselves to injury and displacement, both by reason of their increased size and weight and their less secure anchorage.

Aside from the trauma, the symptoms of true traumatic hydronephrosis do not differ from congenital cystic kidney, or from hydronephrosis acquired in other ways. Closely associated with the injury, there may be hæmaturia, but contrary to the statement of Delbet, this does not occur in all cases. It has been observed in slightly less than 50 per cent. of the cases which have been reported. The size of the hydronephrotic sac varies, according to the nature of the ureteral obstruction. The larger sacs are found where the obstruction has been intermittent or slowly progressive. When the obstruction is sudden and complete, the tumor is apt to be quite small.

Formerly only subcutaneous injuries of a violent nature were deemed capable of causing a true traumatic hydronephrosis. That percutaneous wounds may lead to this condition has been proven by the cases of Marvel and Kroner, the one being a gunshot wound dividing the ureter, the other a bayonet stab.

The probable diagnosis of true traumatic hydronephrosis is based on the preceding traumatic history and the clinical symptoms pointing to a hydronephrosis, viz: a fluctuating tumor, retroperitoneal in position, originating in the kidney and developing insidiously, its contents consisting of more or less altered urine.

The differential diagnosis must take into consideration those other conditions in which a renal tumor is found, and which are observed as direct sequelæ of injuries to the kidney. Among these may be mentioned: (a) hæmatonephrosis, (b) pyonephrosis, (c) pseudotraumatic hydronephrosis, (d) ruptured hydronephrosis.

An absolutely correct diagnosis of true traumatic hydronephrosis can only be made by observing the kidney and sac at operation or autopsy. The characteristic features here are the expanded pelvis, the swelling being a true tumor of the pelvis of the kidney; the dilated calices; the flattened papillæ of kidney tissue, and, lastly, a demonstrable obstruction in the ureter. However, it is to-day possible that by injecting the ureters with silver salts and the use of the X-ray, a kink, twist or obstruction of the ureter may be located and the diagnosis made more probable thereby.

In tabulating the cases found in the literature, different authors have been somewhat at variance with each other—some admitting one case because of its great probability, others rejecting it for lack of indisputable evidence. Any such tabulations must, of necessity, be incomplete owing to the fragmentary reports of some of the cases. In the tabulations given below, only cases of undoubtedly true traumatic hydronephrosis have been admitted; and in every instance the case has been subjected to operation or observed at autopsy.

Case Report.—A. J., male, twenty-two, well built, admitted to St. Vincent's Hospital on August 8, 1910, with the following history: His family and past history negative. Occupation, assistant at a cotton press.

About four months previous (in April), while holding to the end of a long lever by his right arm, he was jerked unexpectedly upward about four feet into the air. Severe pain was immediately experienced in the right loin and kidney region. He was unable to resume work until three days later. There was no hæmaturia at the time of the accident. Except for slight tenderness in the lumbar region, he noticed nothing abnormal in any way until three weeks after the accident. At this time he had

Reporter. Year.	Nature of trauma.	Time elapsed between re- ceipt of injury and appearance of tumor.	Age, Sex.	Size of tumor. Side of body.	Hematuria.	Operation or Autopsy.	Pathological Condition.	Result.
Py-Smith, 1871	Horse kick in abdomen	2 years	24, male	Held 3 quarts. Side not stated.	Yes	Autopsy.....	Impermeable strict- ure of ureter	Died of intercur- rent disease.
Lepine, 1880....	Schrapnel shot	10 years	45, male	"Well marked tumor." Side not stated	No	Autopsy.....	Impermeable strict- ure of ureter	Died of uremia.
Deleitz, 1890..	Number of falls	"A few weeks"	10, female	"Large tumor." right side	Yes	Transperitoneal nephrectomy...	Not described.....	Recovery.
Bardenhauer....	Fall on stairs..	4 weeks	12, male	Size man's head. Left side	No	Nephrectomy...	Kidney a large sac, papillae flattened	Died 1½ years later; amyloid disease.
Postemski, 1893.	Contusion ab- domen	Few days	12, male	"Large tumor," right side	Yes	Nephrectomy...	Ureter severed. Kid- ney a mere large sac	Recovery.
Fenger, 1894....	Severe fall on side	10 years	47, female	"Large tumor." Side?	No	Plastic on ureter	Ureter imbedded in scar tissue and strictured	Recovery.
Wagner, 1894....	Fall on steps..	3 weeks	10, male	"Large tumor," right side	Yes	Nephrotomy....	Calices and pelvis dis- tended. Papillae flattened	Recovery. Pat- ency ureter re- established.
Bartlett, 1895...	Fall from horse	1 year	16, female	Occupied entire left side	No	Nephrectomy...	Stricture ureter. Kid- ney parenchyma de- stroyed	Recovery.
Gerster, 1897...	Fall on side..	6 months	9, male	Size child's head. Side?	No	Nephrectomy...	.....	Recovery.
Marvel, 1899....	Gun-shot in back	10 days	4½, female	Size? Side?	No	Nephrectomy...	.....	Recovery.
Eichler, 1901....	Struck by fall- ing beam	3½ weeks	38, female	Left side.....	Yes	Autopsy.....	Horseshoe kidney, only one ureter, it strictured	Died of uremia.
Delbet, 1903....	Fall from horse	15 months	23, female	Size of fist. Left side	No	Nephrectomy...	Ureter partially con- stricted. Kidney movable	Recovery.
Kroner, 1907...	Bayonet stab.	8 weeks	Adult male	Palpable tumor. Side?	Yes	Nephrotomy....	Blood clot in ureter which regained pat- ency	Recovery.
Schaad, 1907....	"Severe trau- ma."	.....	.....	.....	?	Nephrectomy...	Pelvis of kidney a sac. Dystopic, due to trauma	Recovery.
Perron, 1909....	Kick in abdo- men	Few weeks Short time	.....	.....	?	Nephrectomy...	Whole kidney des- troyed. A mere sac remaining	Recovery.
Cordero, 1909...	.....	.....	.....	.....	?	Secondary ne- phrectomy	.....	Recovery.
Wildholz, 1910..	Log fell on abdomen	3 weeks	25, male	Child's head. Left side	Yes	Nephrectomy...	Stricture of ureter. Pel- vis and calices dilated	Recovery.
Drennen, 1913..	Sudden jerk upward	4 months	22, male	Child's head. Right side	No	Nephrotomy of fixation kidney	Solitary kidney. Ure- ter kinked	Died 1½ years later of uremia.

a suppression of urine lasting 24 hours, and then passed an unusually large quantity within a few minutes.

He was well for two months, when late in June a total suppression came on again, lasting three days this time, after which even a larger quantity of urine than previously was voided.

And again he was well and working, until the last day of July, when a complete suppression of urine set in and lasted up to the time of admission to the hospital on August 8, a total suppression of eight days.

Physical Examination.—The physical examination revealed a large, tensely fluctuating tumor, the size of a child's head, in the right lower quadrant of the abdomen. An impulse in the right costovertebral angle was easily transmitted through the swelling to the anterior side of the abdomen.

The tumor was obviously a collection of urine. A catheter introduced into the bladder found that viscus dry. The patient's condition was such that catheterization of the ureters and X-ray pictures were out of the question. An important question which presented itself was, Why did the left kidney not functionate?

Immediate operation was decided upon, with the intention of exploring the left kidney first.

Operation.—The usual posterior lumbar incision was employed on the left side, but despite a most thorough and careful search, remembering the possibility of the kidney's being placed on the sacrum, or again at the external abdominal ring, as sometimes occurs in the case of rudimentary kidneys, no kidney could be found. The incision was closed.

A similar incision was made on the right side over the tumor. A distinct, thin sac, through which dark fluid could be seen, was at once exposed. Three quarts of dark, foul smelling urine were evacuated. Here and there, between the dilated calices, were to be seen small, flattened masses of kidney tissue. The largest pieces to be found were about the size of a thumb. The whole kidney was an expanded sac. The kidney itself was well down in the pelvis; and about one and one-half inches below the kidney the ureter was kinked at a very acute angle. Attempts to pass an ureteral catheter beyond this angulation were without result. This was undertaken to ascertain the patency of the ureter, and also with the idea of leaving the catheter in place a

few days to splint the ureter and prevent a return of the kink.

A purse-string suture of chromic gut was then passed well down in a puckering manner around the sac and the whole lifted up and sutured to the twelfth rib. A large drain was left reaching into the sac and emerging through the skin and the wound closed about it.

That this is a case of *true traumatic hydronephrosis* cannot be doubted. The history of the injury, and the resulting intermittent hydronephrosis make it clear that the solitary kidney was undoubtedly dislodged from its normal position by the traumatism.

During the first twelve hours after the operation a considerable amount of urine escaped through the lumbar wound, and a half ounce was obtained from the bladder with the catheter. The patency of the ureter had become reestablished. During the second twelve hours, one ounce of urine was voided. He passed more and more urine in the natural way, and at the end of two weeks was voiding over twenty ounces daily, although a considerable amount still escaped through the lumbar wound. At the end of three weeks he was out of bed, passing more than thirty ounces daily through the bladder, and less than an ounce from the lumbar wound, which had almost closed. The urine was always of low specific gravity, about 1008, and contained much pus.

During convalescence he was cystoscoped, and only one ureteral orifice could be found. Attempts at radiographing the ureter injected with collargol were not successful. At the end of three weeks the sac was capable of holding sixteen ounces of fluid injected through the lumbar fistula. At this time, having gained in strength and flesh, he left the hospital for his home in a remote part of the state, and was lost sight of for the next five months. At the expiration of this time, he presented himself for treatment in the hope of having the fistula closed, which was very small and easily controlled by a small piece of rubber tubing with a wooden plug in the end for a stopper. A suggested plastic operation on the ureter to

drain the bottom of the hydronephrotic sac was refused. Under daily irrigations of the sac with weak silver nitrate solutions the fistula closed after two weeks.

Reports from the patient every month thereafter indicated that he was working and enjoying good health in every respect. Exactly one year after the closure of the fistula, which had remained so, he was brought back to the hospital suffering from symptoms of uræmia. The region of the old lumbar scar on the right side was red and fluctuating. A small incision made under local anæsthesia allowed twenty ounces of foul purulent urine to escape. The patient went into collapse, and died a few hours later. By a singularly unfortunate chain of circumstances the autopsy which had been promised was lost.

I am much indebted to Dr. Cunningham Wilson for the privilege of reporting and operating upon this case, which occurred in his service, and to Drs. J. M. Mason and Walter Scott for the cystoscopic work.

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THE CAUSE OF PAIN IN PYELOGRAPHY WITH REPORT OF ACCIDENT AND EXPERIMENTAL FINDINGS.

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ARE the present methods for the injection of the renal pelvis for diagnostic purposes a source of danger? So far as the writer is aware, little or no reference to this phase of the subject has been reported in the literature. In the *Journal of the American Medical Association* for January 18, 1913, Dr. J. G. Thomas, of the Mayo staff of Rochester, Minn., reports the adoption of a gravity method for the distention of the renal pelvis. Other than this, little or no precaution has been taken to accurately determine and gauge both the quantity and pressure of the fluid delivered into the renal pelvis through ureteral injection.

The tendency in modern ureteral catheterization has been toward the use of the larger diameter of the catheter, some of these catheters completely filling the vesical ureter and thereby preventing the return flow of fluid when the pelvis is full and overdistended. The solution is usually forced into the catheter with some form of syringe, and if this syringe is not connected with a gauge or pressure index, the determination of the pelvic capacity is left wholly to the symptom of renal colic expressed by the patient. When this symptom is expressed under these conditions, damage may have already occurred to the kidney, whether water or some form of silver salt has been used. It is the writer's opinion that renal colic is more common in the early history of hydronephrosis, before the pelvis has had time to become stretched and overdistended, and it is in these same cases that renal trauma may easily be induced by such methods. When a syringe with a piston plunger is used, and the fluid is forced into a smaller diameter of tube as occurs with the ureteral catheter, it means that we are dealing with hydrostatic pressure, and the instant that a pelvis refuses to further dilate because of the limit of capacity, it may also mean that actual damage to the cortex

has been done if the pressure continues. This sudden rise in pressure is first detected by the patient, and later transmitted to the syringe, but by this time the damage is already accomplished in the cortex.

The results in the following reported case and the subsequent experiments have prompted us to adopt a simple method whereby one can determine the exact quantity delivered into the pelvis as well as determine the actual pressure of the fluid being transmitted through the catheter. This is done by attaching the ordinary mercurial blood-pressure manometer to one end of a Y with an air cushion interposed between the manometer and fluid, while the fluid is discharged under pressure from a graduated glass cylinder. Accurate determinations of both quantity and pressure may be taken at all times during a sitting.

The recently published method of Dr. Thomas already referred to, is, no doubt, a much more practical method of distending the renal pelvis where gravity is sufficient, for the technic and apparatus necessary for the gravity system is much more simple.

Report of Case.—Female, age twenty-four years; married at twenty-one. Menstruated at thirteen, but very irregularly until after marriage; now of the twenty-eight-day type, and of seven days duration. Parents both living and well, and family history otherwise negative. Patient has never been well and strong, although the invalidism has had little bearing on her present trouble. She has had a chronic constipation and excessive accumulation of gas for many years, and for the past year has had frequent and severe attacks of pain radiating down over the right iliac crest and into the region of McBurney's point. This last symptom has caused several surgeons to make a diagnosis of chronic appendicitis. She had been directed at various times to abstain from solid food, and has been on a liquid diet for the past six weeks. Her weight three years ago was 124 pounds, the present weight 112 pounds. On Röntgenologic examination by Dr. G. H. Stover the patient was found to have complete transposition of the organs and the diagnosis of appendicitis was therefore deferred until after a cystoscopic examination was made with double ureteral catheterization.

After determining the approximate capacity of each renal pelvis, a 15 per cent. collargol suspension was injected with a piston syringe; the right pelvis holding 20 c.c., and the left 16 c.c. There was considerable pain following this trial, but the skiagrams were not satisfactory. Because of this failure the pyelographic work was repeated after the lapse of some five weeks, and a 25 per cent. suspension was used. At this time 12 c.c. were injected into the right ureter and 10 into the left, when pain became excruciating especially on the right side.

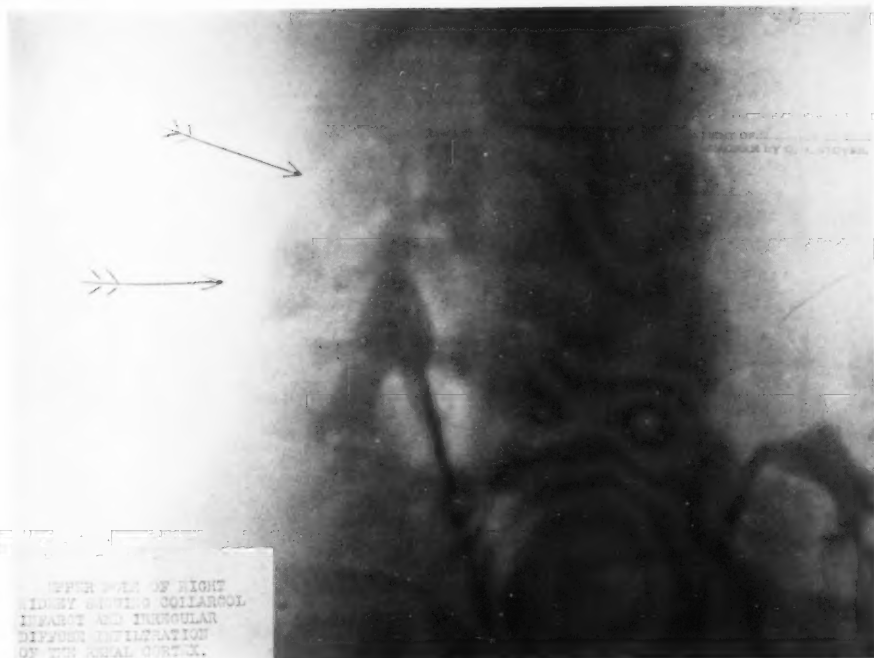
The skiagrams at this time gave quite clear views of both pelvises, that of the right being large and irregular as compared with the normal left (Fig. 1). There was also observed a marked shadow well out in the parenchyma extending from the centre of the right kidney, infiltrating into its upper pole. Many theories were advanced for this shadow, and it was finally assumed that there was a diseased area connected with the renal pelvis which the pressure of the fluid had opened and the collargol penetrated. A slight rise in temperature which continued for three days followed this catheterization.

An exploratory incision being advised and accepted, some two weeks after the last ureteral catheterization, the right kidney was exposed and it was found to be ptosed and enveloped in a great amount of inflammatory adhesions. When the kidney was finally released from this bed of adhesions, a large wedge-shaped area of kidney substance about two inches wide was found to be infiltrated with the collargol and the capsule covering this infarct was lifted from the parenchyma by a layer of collargol. This mass or infarct was found to extend down to the renal pelvis, and was resected without going into the pelvis. The kidney was then turned over so that the pelvis was at the low point, and anchored at a higher plane. The patient had an uneventful recovery with relief of symptoms. The mass was then submitted to Dr. Ross C. Whitman, Professor of Pathology in the University of Colorado, whose report and illustrations follow.

PATHOLOGICAL REPORT.—The gross specimen measures 5 x 7 x 4 cm., consistency about normal. An area under the capsule, 3 cm. in diameter, is raised and black. The capsule peels readily, leaving a smooth surface. On section the black discoloration is seen to extend in the form of a broad wedge or fan towards and deep into the tip of the pyramids. The discoloration is distributed in columns corresponding to the tubules. (Fig. 2 enlarged about four times.)

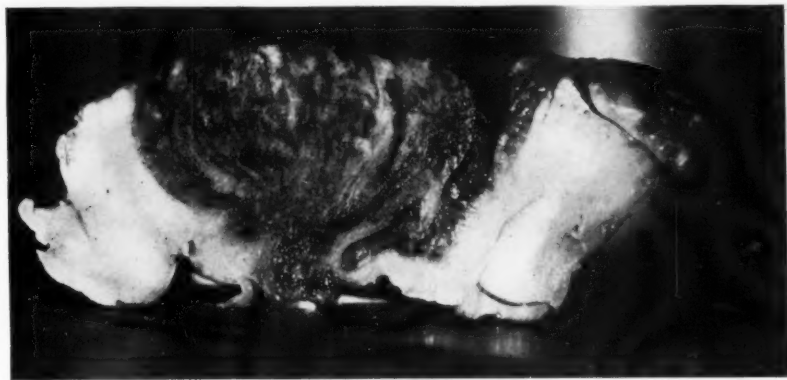
Histological Examination.—The tissue was fixed in formalin, and

FIG. 1.



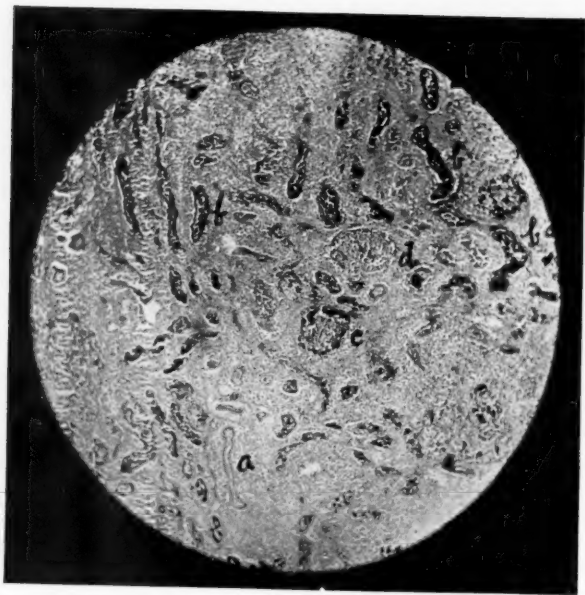
Upper pole of right kidney showing collargol infarct and irregular, diffuse infiltration of the renal cortex.

FIG. 2.



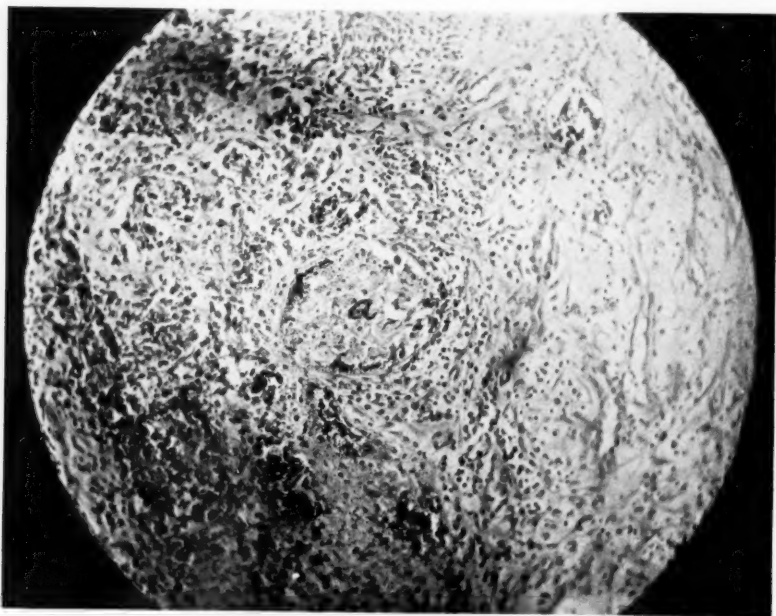
The collargol extends in the form of a broad wedge or fan from the tip of a calyx well out into the cortex and under the capsule. (Enlarged about 4 diam.)

FIG. 3.



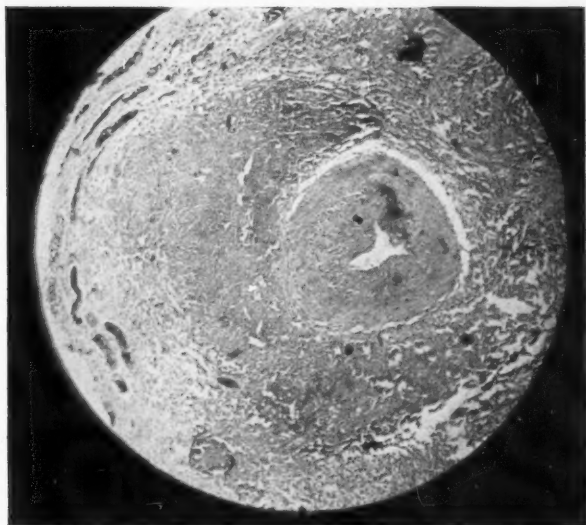
Tubules and glomeruli containing collargol pigment (*a* and *d*) in small quantity, or as a thin layer closely applied to the cells. Tubules filled solidly with a dense mass of collargol and small admixture of cells and detritus (*b* and *c*).

FIG. 4.



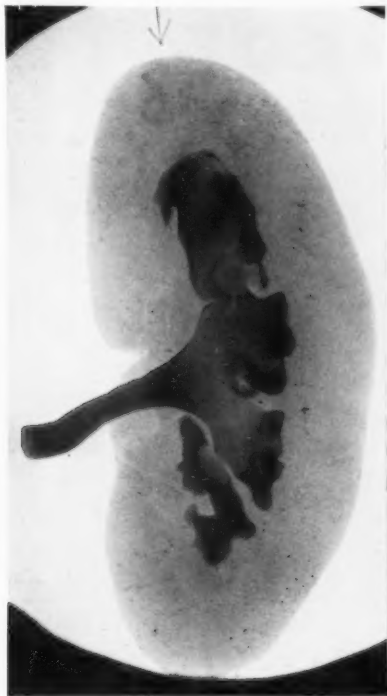
a, glomerulus containing a relatively small quantity of collargol pigmentation with a thin layer closely applied to the peripheral cells, also an intracellular infiltration of collargol.

FIG. 5.



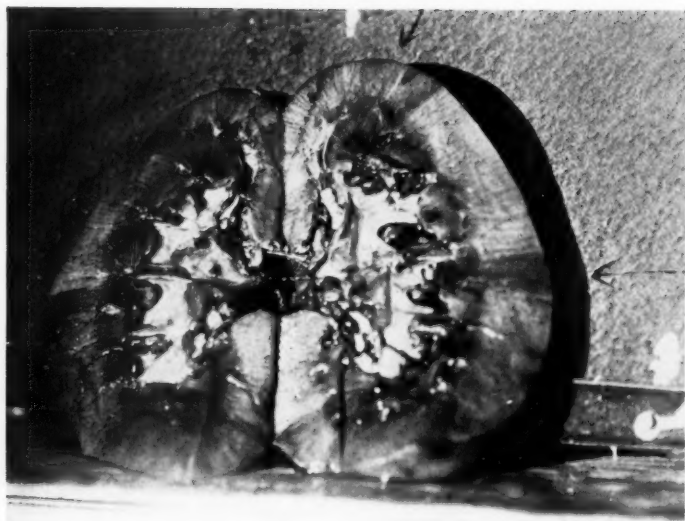
Vein with marked thickening of the intima, media containing small deposits of collargol, and surrounding all a massive exudate with cellular necrobiosis.

FIG. 6.



Fresh pig's kidney injected with 14 c.c. collargol at 50 mm. for five minutes. Wedge-shaped infiltration of collargol at upper pole (stereoskiagram).

FIG. 7.



Pig's kidney: Arrows pointing to the areas invaded by the collargol. This substance can be seen in the proximal convoluted tubules and under the capsule.

sections stained with hemotoxylin and eosin, and with hemotoxylin and carbol-fuchsin. The most painstaking search fails to reveal the presence of tubercle bacilli. The tubules contain a black substance (collargol) distributed through their entire length and extending into the glomeruli. In certain tubules and glomeruli a relatively small quantity is present, and is then found as a thin layer closely applied to the cells. (Figs. 3a, 3d and 4a.)

These doubtless represent tubules which were involved by the first injection of collargol, in 15 per cent. suspension and which escaped invasion at the later injection. Other tubules are filled solidly by a dense mass of collargol, or at most, a certain small admixture of cells and detritus. (Figs. 3b, c and 4.) These are the tubules involved by the second injection of more concentrated suspension.

In either case the tubular epithelium is, with very few exceptions, completely necrotic. Certain tubules have completely broken down, permitting the collargol to diffuse through the surrounding tissue. In a few tubules, however, the epithelial nuclei still stain, but show necrobiotic changes, viz., karyorrhexis and karyoschisis. In addition the cells contain globules of collargol, indicating that the cells have exercised a phagocytic function. (Fig. 4.) This same illustration shows at its centre a glomerulus containing collargol. The capillary endothelium is swollen and hydropic, and the capillary tufting has entirely disappeared. No wandering cells (leucocytes) are present. The glomerulus is converted into a cell mass somewhat resembling a young tubercle.

The tubules are widely separated by cellular exudate, which is, however, so badly degenerated that for the most part little can be made out as to the character of the cells composing it. Here, also, as in the tubules, there is marked karyoschisis and karyorrhexis. In a few areas the cells composing the exudate are better preserved. Here the cells are chiefly mononuclears, viz., endothelial leucocytes, lymphocytes and lymphoblasts, and plasma cells. In one area only was found a collection of eosinophile polynuclears, and myelocytes.

Fig. 5 shows a vein with marked thickening of the intima. The media contains many small droplets of collargol and about the vein is a massive exudate, the cells of which are necrobiotic. Outside of the affected area, the kidney is œdematous. There are a few obliterated glomeruli and here and there moderate or slight proliferative capsular glomerulitis.

It seems possible to reconstruct with fair accuracy the course of the changes which have taken place. The fluid having found its way into the tubule, passed through its entire length, and excited changes analogous to those seen in tubular nephritis of toxic origin. The exudate collects partly under the influence of the collargol itself, but no doubt chiefly under the influence of decomposition products derived from the destroyed parenchyma. It is noteworthy in this connection that the cells of the exudate correspond closely in character with those ordinarily found in toxic tubular (acute interstitial) nephritis. Since in the latter condition a complete *restitutio ad integrum* occurs, provided the patient survives the early stages of the process, it is not unlikely that the present case

might have had such an outcome without surgical aid. But it is equally probable that a similar accident has frequently occurred in the past, but has passed unrecognized. It is hardly arguable that a diagnostic method which involves such a possibility is altogether safe or permissible.

After learning the real nature of this shadow a series of experiments were undertaken on the fresh pig kidney, twelve being used in the experiments. The kidneys were taken from the freshly killed hog and the tests applied within one hour after their removal from the animal. A device had been so fitted that it connected with a manometer and a graduate reservoir containing the collargol suspension, so that the amount of fluid used could be determined at the same time that the intrapelvic hydrostatic pressure was measured. A catheter was inserted into the ureter of the freed kidney and tied in place so that there might be no return flow, securing uniform conditions comparable with those which occur when the catheter completely fills the lumen of the human ureter.

The first kidney tested was of course given a greater quantity and pressure than was necessary, but the results were so like those found in the patient's kidney that further study was made. The infiltration of the parenchyma and free diffusion of the collargol under the capsule was almost simultaneous with the distention of the pelvis and the recording device indicated the use of 18 c.c. of collargol at a pressure of 240 mm., a compressed air device being used in this test.

Kidney number two was then tried and a distinct wedge-shaped infiltration occurred which extended out under the capsule in about one minute with the use of ten c.c. of fluid at a pressure of 80 mm. of mercury. Kidney number three had an injection of 14 c.c. of fluid at 50 mm. for five minutes, this test giving practically the same results as the earlier experiments, and this kidney was then placed on photographic plates and X-ray negatives made of it with the resulting shadows as here shown (Fig. 6).

Following this the balance of the kidneys were treated in a like manner but using a small glass syringe in place of the compressed air. The same results were again secured with 16 c.c. of collargol delivered at a pressure of 40 to 80 mm. A test was then made to determine the average pressure when

delivering such a fluid from an average piston, hand syringe, through a number seven catheter and into the renal pelvis. After some four tests it was found that the average was 60 mm., the pressure varying from 40 mm. minimum to 80 mm. maximum.

Sections were also studied by Dr. Whitman from one of the pig's kidneys (Fig. 5) into which collargol had been injected. This kidney is shown in Fig. 7. The arrows point to the areas invaded by the collargol. Dr. Whitman's report follows:

"Sections through the area discolored by collargol show the latter within some tubules, sometimes as a solid mass lying free in the lumen, sometimes as a thin membrane adhering closely to the surface of the epithelial cells.

"Tubules of every class are involved. The collargol can be found even in the proximal convoluted tubes just outside of the glomerulus, but no glomeruli containing collargol are found.

"Inflammatory changes are of course absent, nevertheless the collargol is found here and there within the cells of the tubes, in essentially the same manner as in the tissues from the patient (shown in Fig. 4). This can only be explained on the assumption that the cells still retain, in part at least, their phagocytic properties, by virtue of which they have actively taken up particles of the collargol."

I am indebted to my assistant Dr. F. H. Carpenter for valuable assistance in these experiments.

NOTE BY DR. STOVER.—Out of some forty instances of injection of the ureter and renal pelvis under pressure, for the purpose of demonstrating an early hydronephrosis due to ureteral obstruction, I have seen but two examples of infiltration of the renal parenchyma. I have known of no later-appearing evidence of damage to the renal tissue. Yet I favor the use of a standardizable gravity injection method, and think this would obviate the present small possibility of harm from renal collargol instillation. The cuts here reproduced of the stereoskiagram show the whole kidney blotched, while the area of infiltration was really confined to the upper pole area.

PRIMARY TUBERCULOSIS OF THE GLANS PENIS.

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PRIOR to the advent of present-day methods of asepsis and antisepsis, it was not all uncommon to see cases of primary tuberculosis of the penis follow non-ritual circumcision. Perlis¹ and others have reported cases in which tuberculous infection following the simple operation produced complete destruction of the organ.

The disease usually attacks the foreskin or prepuce. It may appear first in the body of the penis, although it very rarely attacks the glans primarily. The disease usually manifests itself in the form of a small ulcer which becomes progressively larger. The disease is usually secondary to infection elsewhere in the body.

The following case seems of special interest owing to the advanced age of the patient, the primary site and cicatricable character of the growth, the absence of evidence of tuberculosis elsewhere in the body, and the mode of onset of the disease.

REPORT OF CASE.—Patient, M. B., white male, age 72, retired soldier, was referred to my service at the Deaconess Hospital by Dr. Vinyard, of Jackson, Mo., with the history that about six months before he had noticed a small, hard nodule in the glans penis about midway between the corona and meatus. The growth was painless and did not interfere with micturition, but became gradually larger until at present it is larger than a filbert. The man was well nourished and in apparent good health. The dorsal surface of the glans is bulging. A very firm, smooth, oval-shaped mass occupies the greater portion of the glans. The urethra is not involved and the patient urinates without trouble.

¹ Perlis: *Czasapisino lek.*, Lodz, 1899, 1, 313.

FIG. 1.



Author's case of tuberculosis of glans penis. Note the cicatricial growth occupying the upper half of the growth.

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The age of the patient, the mode of onset and the very firm consistency of the growth suggested the possibility of malignancy. The possibility of calcareous deposit and of bony growth was considered. A frozen section of the growth was examined by Dr. Tiedemann and malignancy was excluded. A few days later Dr. Tiedemann reported the growth to be due to tuberculosis of the glans penis.

The growth was then excised. The appearance presented by a median section of the growth is shown in Fig. 1.

ON THE FORMATION OF BONE IN THE HUMAN PENIS.

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AND

F. S. MANDLEBAUM, M.D.,

OF NEW YORK.

Pathologist to the Mt. Sinai Hospital.

THE fact that the formation of bone in the human penis is one of the rarest of phenomena may serve as an excuse for presenting a paper based on the observation of a single case.

CASE REPORT.—John B., male, Frenchman, restaurant keeper, 49 years old, married. There was a history of syphilis, no gonorrhœa, no acute infectious disease. Patient had worn a pair of corsets of the straight front type for three years. About eight months ago he noticed at the place where, in the sitting posture, the lower anterior rim of the corsets impinged on the upper aspect of the root of the penis, the appearance of a small indurated mass the size of a pea. Gradually this mass extended downward along the middle of the dorsum of the organ, until it reached its present size. The presence of this body caused the patient no inconvenience whatever, except in erection of the penis, when an increasing amount of upward incurvation acted as an insurmountable obstacle to the introduction of the organ into the female genital tract. On October 3, 1910, the following was noted:

Status Præsens.—Florid, somewhat obese man. Pulse 80, temperature normal. Arteries somewhat hard. Lungs and heart normal. Abdomen obese and pendulous. Liver palpable, not painful; spleen non-palpable. Genitals well developed. Close to where the penis emerges from underneath the symphysis pubis, an oblong, lamella shaped, very hard body can be felt resting upon the dorsum, extending forward to the extent of 3.5 cm. It's width is 1.75 cm. It occupies the middle space

exactly. The thickness is estimated to be about two or three millimetres. There is considerable subcutaneous lateral mobility which easily permits a tilting on edge from either side, the tilted body then assuming the shape of a longitudinal crest. No longitudinal mobility. The Wassermann test proved to be negative. Urination unimpeded. Urine of high specific gravity (1018-1022), clear, dark amber, acid; no albumin, no sugar, no blood, pus, or casts.

October 15, under light gas and ether anæsthesia extirpation of the body. Artificial anæmia by constriction of root of penis. Longitudinal median incision down upon the body, severing the penile fascia. Very easy dissection of the lateral margins; the inferior attachments of the osseous body to the tunica albuginea and to the septum penis demanded cutting. After the removal of the body a defect of the tunica extending over both corpora cavernosa was visible. Catgut suture of tunica albuginea, release of the constrictor, ligature of two small arteries, suture of the fascia and skin, together with a small compressive dressing completed the little operation. Uneventful primary healing followed.

February 24, 1911, patient reported that the upper incurvation had been sufficiently reduced to permit satisfactory sexual intercourse, but was still apparent. He feared a return of the condition.

The pathological findings of the specimen were as follows:

Pathological Report.—The specimen measures 3.5 cm. x 1.7 cm. x 2 to 3 mm., and is a flat, thin plate of tissue containing areas of bony hardness. The specimen is covered on one side by dense connective tissue of a whitish color, and on the other side by tissue of greyish white color. An X-ray photograph shows a dark shadow running in an irregularly serpentine fashion from side to side, and one extending longitudinally. After fixation and hardening in alcohol, several pieces extending across the entire specimen were decalcified in nitric acid, 5 per cent., and imbedded in celloidin. The cut sections were stained by various methods.

The bone runs through the middle portion of the sections, and the surrounding tissues are of different character on either side. On one side there is a layer of extremely dense fibrous tissue, showing a moderate number of compressed nuclei and a few small blood-vessels, and staining faintly with hæmatoxylin. Although a sharp line of demarcation is noted between the fibrous tissue and the bone, the two are in close relation. The different staining qualities of the two types of

tissue are seen at a glance. On the other side of the bone a narrow zone of the same type of dense fibrous tissue is seen. Beyond this is a layer of muscle fibres, loose connective tissue, and small blood-vessels. The dense fibrous tissue just described represents the tunica albuginea, and the bone formation has taken place in this tissue.

The bone shows characteristic Haversian canals of various sizes, surrounded by more or less prominent concentric lamellæ and lacunæ. Some of the canals are of minute size and apparently empty; larger ones show the presence of cells having all the appearances of marrow cells. Running through the middle of the bone are several large oval shaped canals. Many of these contain true marrow and large multinuclear cells (osteoclasts?) and probably represent an attempt at the formation of a true central canal.

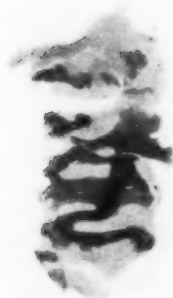
At the junction of the bone with the fibrous tissue on both sides, typical osteoblasts are seen in many places. In these situations narrow layers of faintly staining tissue of an osteoid character are noted. Here and there are deposits of calcareous matter with the characteristic staining reactions. These areas are occasionally very dense and homogeneous; some of them, however, show distinct lime particles. Osteoclasts are present in these situations in small numbers. Surrounding many of the areas of lime deposits are zones of young vascular connective tissue and osteoid tissue. In some places small blood-vessels are seen running from the fibrous tissue into the bone. These are not unlike the periosteal buds seen in the normal formation of bone from cartilage, but in none of the sections is there the slightest evidence of the presence of cartilage cells.

In searching the literature of this subject, it was found that the condition presented in this paper is of the utmost rarity. Paul Frangenheim, in describing the facts bearing upon a case observed in Lexer's clinic at Königsberg, has written a very instructive paper containing most of the observations on this subject up to 1907.¹ From this paper the following particulars of interest may be mentioned: Sachs² had collected the records of 187 cases of the so-called *plastic induration* of the penis. But up to 1907 specimens for actual examination were secured only eleven times, in five cases by operative removal of the indurated parts, and in six cases by autopsy. Among the latter the only American case was that of Chetwood. Since then are to be added four cases by Zur

¹ Deutsche Zeitschr. f. Chir., vol. xc, p. 480.

² Vier Fälle von sogen. plast. Induration, etc., Wiener klin. Woch., 1901, No. 5.

FIG. 1.



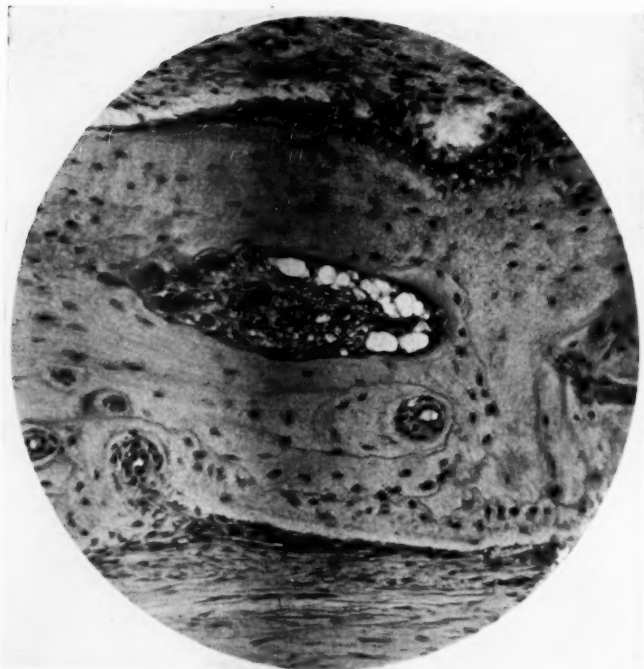
Skiagram of specimen. Dark bands represent bone tissue.

FIG. 2.



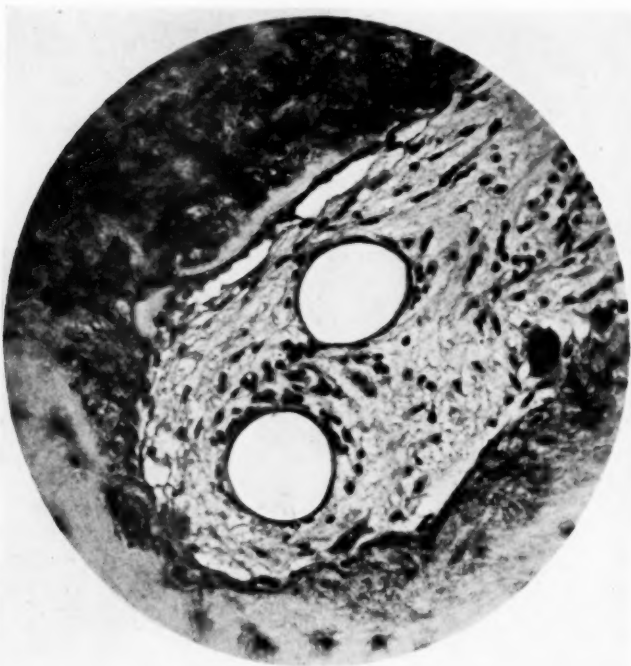
The entire field, excepting areas of fibrous tissue above and below, shows newly-formed osseous tissue.

FIG. 3.



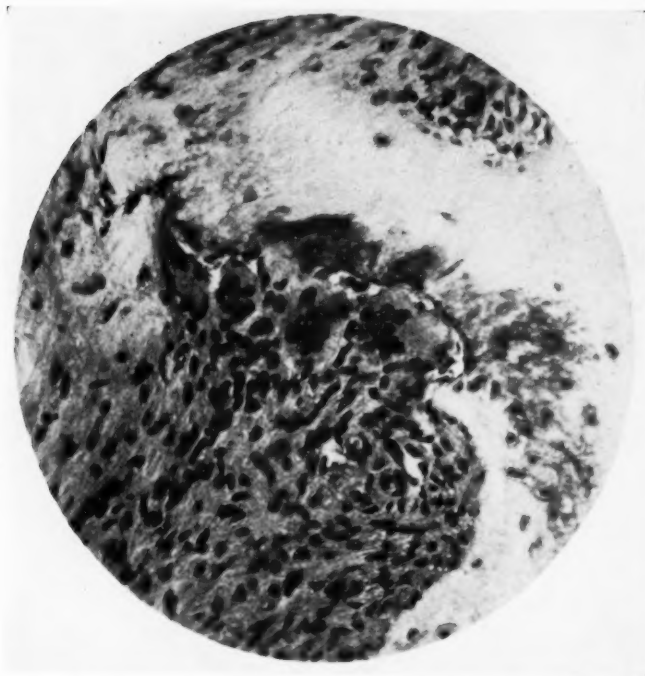
Osseous tissue showing Haversian canals and section of a marrow cavity. In the latter are several giant-cells (osteoclasts?).

FIG. 4.



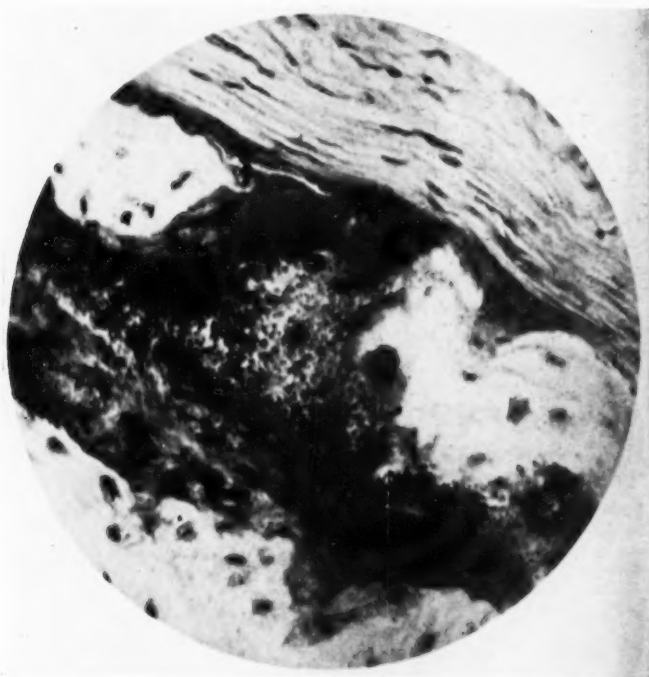
Section of marrow canal. The dark area above is calcareous matter; on the right is an osteoclast; to the left and below osseous tissue is seen.

FIG. 5.

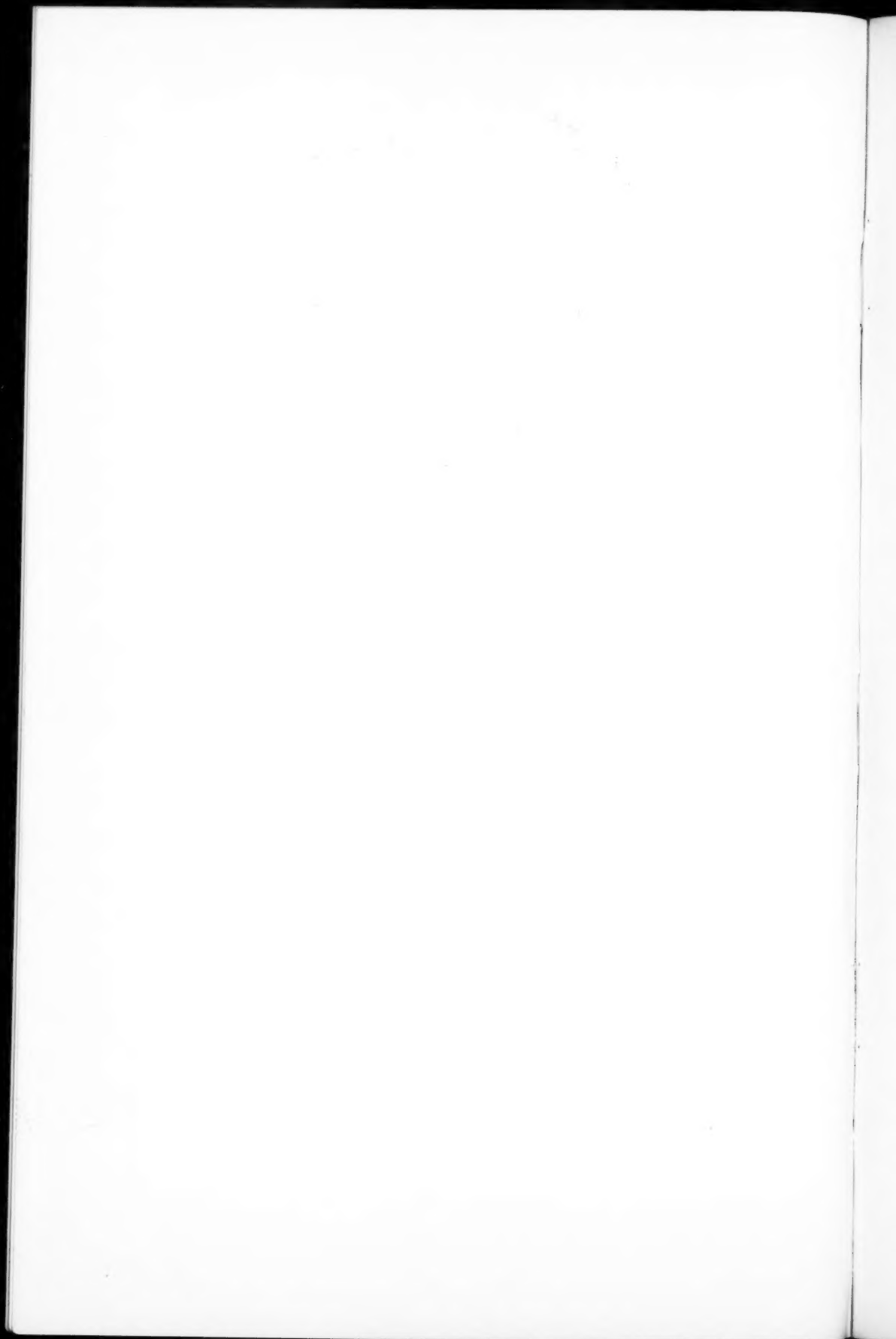


Most of the field is occupied by young vascular connective tissue. On the right is an area of osseous tissue and calcareous matter. The pale band above is osteoid tissue. Five osteoclasts are seen in the centre of the field.

FIG. 6.



The darker portion represents an area of calcareous matter which is nearly surrounded by osseous tissue. The osteoblasts between the two are not clearly seen in the photograph.



Verth (Kiel)³ and this, our own case, which makes the sixteenth.

There is no reason to assume that the ossification of certain parts of the fibrous structures of the human penis stands in a morphological relation to what is observed in certain quadrupeds under the name of *os priapi*. Mayer's endeavor to prove such a relationship by the description of a penile cartilage in the glans of the negro was rejected by Hyrtl, who found that the problematic cartilage lacked the characteristic structure and was nothing but a thickening of the anterior portion of the septum of the corpora cavernosa.

Among the etiological factors determining ossification of parts of the tunica albuginea, and the corpora cavernosa, Sachs mentions gonorrhœa, syphilis, diabetes, rheumatism, and traumatisms. Each of these affections may be accompanied by characteristic deposits leading to induration and ossification. Traumatisms, causing minute hemorrhages, may also have their share in the causation. Zur Verth, who limits the term of *plastic induration of the penis* exclusively to the cases of elderly men, in whom a slow and painful development of lamella shaped bodies on the upper surface of the penis undergoing osseous transformation is observed, attributes the phenomenon to two factors: The first one is an arteriosclerosis due to systemic causes such as were enumerated above; the second are the many small traumatisms accompanying erection and the sexual act, or in fact any other non-sexual traumatism, such as was noted in our case in the frequent impingement of the unyielding and sharp edge of a corset where the root of the penis is immovably fixed to the symphysis pubis. The primary seat of the induration is the fascia penis, which is very rich in elastic fibres. The process is analogous to the degeneration of the elastic fibres of the blood-vessels caused by the disorders of assimilation in the senile state, especially in the presence of intoxications and traumatisms.

³Zentralbl. f. Chir., 1912, p. 1743.

All the cases heretofore observed occurred in men between the ages of forty and seventy-four, except in one (Brohl's), where the condition was present at twenty.

Osseous deposits in the penis generally assume the shape of bodies of a lamellary or testaceous form. Very often their continuity is interrupted by round or irregular defects or perforations filled in with connective tissue. Their osseous components are deposits of a very irregular serrated outline. In our case the Röntgen shadow demonstrated that the bony deposit formed a serpentine meander wound about a longitudinal staff, remotely comparable to the *Æsculapian* symbol. None of the bodies obtained at autopsy or by surgical operation exceeded a thickness of two or three millimetres. Most of them were found occupying the internal aspect of the tunica albuginea of the dorsum, occasionally extending into the septum, the corpora cavernosa, and in Chetwood's case into the erectile parts of the urethra and its anterior extension, that is, the glans penis.

The complaints caused by the disorder are interference with urination and with intercourse, the latter consisting in pain at erection or at seminal ejection. Abnormal angulation or curvature of the penis on the side of the deposit is the rule.

Frangenheim's careful study of the minute processes connected with ossification were fully borne out by our investigations, demonstrating the presence of a well-defined layer of osteoblasts, which are distributed along the anterior circumference of the bodies,—that is, there where extension by growth is mainly observed. The practical conclusion to be drawn from this fact is the importance of removing with the body itself a small portion of the tunica adjoining its anterior extremity. If this is not done, a relapse may follow, as happened in Stromeier's case.

The changes wrought by age in the human penis were carefully investigated by Schurygin,⁴ who found that the

⁴ Über die pathol. anat. Veränderungen membri virilis im Griesenalter, Wiener med. Presse, 1898, No. 44.

blood-vessels, nerves, and nerve endings were invariably and characteristically altered. These changes, with superimposed minute traumatism, offer a plausible explanation of the genesis of the affection, a view which is not fully accepted by Frangenheim, but is advocated by Zur Verth, and is endorsed by ourselves. Siegmund's theory of the ossification of the lymphatic vessels and Waelsch's⁵ assumption of the presence of chronic phlebitis and periphlebitis as causative factors are not borne out by our findings.

Although the occurrence of bone formation in various organs is not at all infrequent, the underlying causes, as well as the exact mode of its production, are still unsolved. From a study of the material in this case, it seems not unreasonable to assume that the bone has been formed in the connective tissue by a process of metaplasia. The presence of the osteoclasts and the young connective tissue and their relations to the lime salts seem to warrant this assumption.

⁵ Über die Induratio penis plastica. Münchener med. Wochenschrift, 1906, No. 41.

ANTERIOR GASTRO-ENTEROSTOMY.

REPORT OF A CASE OF DIVERTICULA OF THE JEJUNUM.

BY DONALD C. BALFOUR, M.D.,

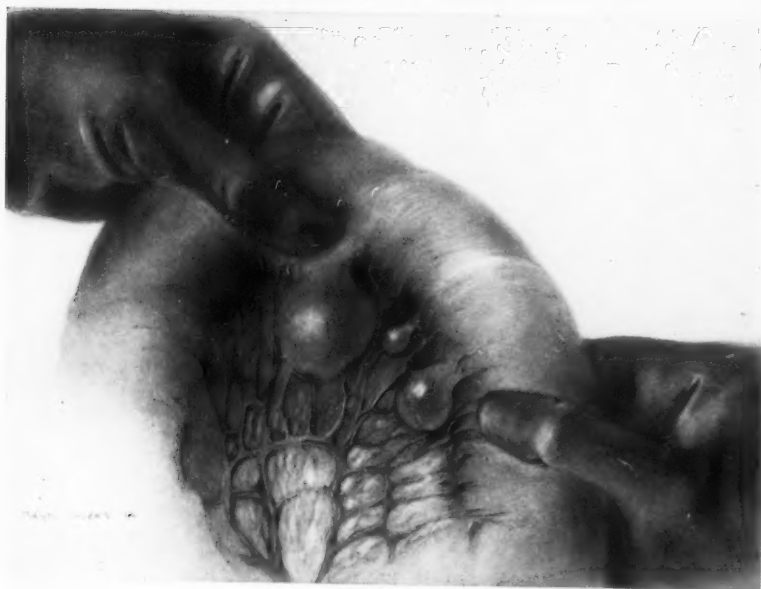
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It is generally conceded that when a gastro-enterostomy is indicated, the posterior no-loop operation is safer, gives the best end-results, and that it carries practically no risks of unfortunate mechanical sequelæ. The method has been so consistently satisfactory that it may have been used at times when other methods would have sufficed as well or perhaps better. It is particularly applicable for benign lesions in the region of the pylorus when a resection of the pyloric end of the stomach is not indicated or some type of plastic operation is not possible.

For various reasons an anterior gastro-enterostomy is the operation of choice in certain definite groups of cases, the largest of which is composed of the obstructions at the pylorus due to carcinoma in which a resection of the growth is not feasible. In many of these cases the mechanical obstruction with retention of decomposed food products and the resulting starvation are the important factors. These patients are not only greatly relieved temporarily by drainage of the stomach but the terminal stages of the malignancy are much less pitiable. It is particularly in this type of case that the anterior method is preferable on account of the speed, safety and simplicity with which it can be performed. A smaller group is composed of certain benign lesions at or near the pylorus where a posterior gastro-enterostomy would be desirable, but not possible because of the presence of certain mechanical conditions. Extensive adhesions, congenital or inflammatory, malformations, etc., may be sufficient to preclude the advisa-

FIG. 1.



Upper jejunum, showing the three diverticula.

FIG. 2.



Anterior gastro-enterostomy completed, showing the single mattress suture uniting intestine to stomach one inch either side suture line.

W. H. P.

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bility of attempting the posterior method, and yet permit the anterior operation to be done safely and quickly. The case herewith reported is illustrative of such a possibility:

CASE A70173.—J. Mc., male, aged sixty-two years. Examination July 5, 1912. No family history of importance and no previous definite illness. Personal history extending over some 20 years of gastric distress which suggested a lesion of the duodenum. The symptoms were somewhat irregular, the chief complaint being a dull epigastric pain coming on about an hour after meals and continuing until the next meal, when the food relieved the pain. There had been no vomiting, no evidence of bleeding, no jaundice and no evidence of acute trouble, no definite history of hyperacidity or hypersecretion. The physical findings were not indicative and the analysis of the stomach contents showed a total acidity of 77, free Hcl. 70, and combined Hcl. 8. The long-standing trouble, and a loss of weight during the past few months warranted an exploration and the patient was referred to the hospital.

Operation (July 12, 1912).—A right rectus incision was made to expose the pyloric end of the stomach and duodenum. A large thick calloused ulcer was found involving the pylorus and extending $2\frac{1}{2}$ or 3 inches down the duodenum. The ulcer involved the greatest part of the anterior surface of the duodenum and the peritoneum showed evidence of recent inflammation. The stomach was negative from the anterior view, the gall-bladder was negative, the appendix showed well-marked evidences of disease and was removed.

The lesion and its situation were typical of the group in which such satisfactory results are obtained by a posterior gastro-enterostomy and this operation was decided on. On lifting the transverse colon extensive and apparently long-standing adhesions were found binding the mesocolon and mesentery of the jejunum for several inches along the first part of the jejunum. An examination of the upper jejunum showed the presence of four well-marked diverticula, all showing the same formation. Three of these diverticula were about 16 inches from the origin of the jejunum and within 1 inch of each other, while the fourth was about 4 inches from the duodenojejunal juncture. They varied in size from a hazel nut to an English walnut. All were

on the mesenteric border of the jejunum and, since they could be collapsed and would rapidly distend when pressure was removed, were definitely connected with the intestine. They evidently were not causing symptoms and were left undisturbed. Examination of the remaining part of the small bowel showed no other diverticula.

The situation and density of the adhesions to the mesocolon and mesentery of the jejunum, the amount of trauma necessary in order satisfactorily to free the jejunum made the posterior operation a questionable procedure, and the anterior operation was decided on. This decision was reached after eliminating the possibility of excision or performing a plastic closure of the ulcer itself, chiefly because of its size and the amount of induration surrounding it.

The anastomosis was made just beyond the three diverticula. Probably the most important step in this operation is directed toward the prevention of a kinking at the line of union between the stomach and the intestine, which would mean obstruction and vicious circle. This step is accomplished by a simple method, namely, the Hartmann modification of the Kappler technic, introducing a suture of linen between the stomach and jejunum about 1 or $1\frac{1}{2}$ inches beyond the extremity of the outside suture line on each side after the anastomosis is completed. This gives the jejunum an attachment to the stomach of nearly double the length of the actual gastro-enterostomy opening and sharp angulation of the actual opening between the stomach and jejunum cannot take place. This method of hitching up the jejunum has probably been the means of preventing the unfortunate complications which were so common following the earlier methods of anterior gastro-enterostomy and for which an entero-anastomosis was so frequently made as a part of the operation.

The patient recovered and was dismissed from the clinic in good condition, and a letter received recently states that he has had no further trouble.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY.

Stated Meeting, held February 3, 1913.

The President, DR. GWILYM G. DAVIS, in the Chair.

SYMMETRICAL ODONTOMA OF BOTH SUPERIOR MAXILLÆ.

DR. MORRIS BOOTH MILLER presented a female mulatto child two years of age. The history briefly is as follows: She was born on February 3, 1911, prematurely a little less than seven months after conception. Her mother has since given birth to another child by the Cæsarean route. While the child was prematurely born, she seemed to get along well until last summer, when it was noted that her face was changing in outline, and the mother and grandmother thought she was getting fat. The dentition of the milk teeth was apparently normal so far as could be learned. There is nothing else of significance in the history.

There are abundant signs of rickets as shown by the beaded condition of the ribs, epiphyseal enlargement, and bowing of the limbs. The child shows a positive von Pirquet reaction, negative Wassermann, and the blood count gives no variation from the normal except a low polymorphonuclear count, 31 per cent., the lymphocytes being 41 per cent. and the large mononuclears 22 per cent. There is nothing of interest in reference to the nose condition.

It will be seen on examination that there is an extensive overgrowth of the entire alveolar portion of both jaws but not extending beyond the alveoli (Figs. 1 and 2). The general effect upon the face is to slope the facial angle to an accentuated degree of prognathousness. The palate arch is lowered. The overgrowth in each jaw is perfectly symmetrical on either side of the midline, and from within out there is an equal amount of swelling on both sides of the line of the teeth (Broca's sign) (Fig. 2). The latter are widely spaced, show the loss of enamel

often seen with rickets, and are distinctly springy when pressed on. The mucous membrane is tense, but otherwise not altered. To the touch the growth feels cystic, or rather as though a cyst or cysts were under a thin lamella of bone.

Slow growing unilateral jaw tumors are not infrequent in colored people and often attain huge size. These are commonly odontomata and are either cystic or adamantine in character. In this case the symmetry and the involvement of both jaws would place it within a separate class. The appearance of the growth subsequent to the eruption of the first teeth would assign it to irritation of all of the dental follicles of the permanent

FIG. 1.



Odontoma of superior maxillæ.

teeth occurring simultaneously and evenly in both jaws. The skiagraphs show very immature and widely scattered teeth of the permanent set.

This child was seen at the Polyclinic Hospital by Drs. Hamill, Cryer, Müller, and Bloodgood of Baltimore, and such a condition had not been seen by any of them before.

INCISED WOUNDS OF WRIST AND FOREARM.

DR. MÜLLER presented a man aged thirty-five, who was admitted to the Polyclinic Hospital, October 22, 1906, with an extensive injury of the left forearm as the result of being struck

FIG. 2.



Odontoma involving both superior maxillæ as seen upon retraction of lips.

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in two places with a butcher's cleaver. On the anterior and radial aspect of the arm near the wrist there was a long oblique wound which severed the tendons of the flexor carpi radialis, extensor ossis metacarpi pollicis, extensor primi internodi pollicis, the radial artery and the radial nerve. The radius had a chip cut from its lower end, a slice of bone was cut from the base of the metacarpal of the thumb, and the wrist joint was opened. On the ulnar surface there was a transverse wound which cut through the ulna and the adjacent muscles at the junction of the upper and middle thirds.

In the wrist wound the pieces of bone were sutured in place and the joint closed without drainage. The radial artery was tied but the severed nerve and tendons were carefully sutured. The upper arm wound also involved muscle suturing. The patient made a smooth aseptic recovery. Six years have now elapsed and it is interesting to note the full strength and normal mobility of the structures affected and the perfect restoration of sensation over the distribution of the radial nerve.

DR. J. LEON HERMAN presented a specimen of dumb-bell kidney, and discussed the subject of such malformation in a paper for which see page 868.

DR. J. CHALMERS DA COSTA said that recently he had blundered on one of these cases in his clinic. He thought he had a hypernephroma to deal with and after working for an indefinite period found out what he really had, and decided to retreat. The renal band went from the top of one kidney across to the other. The ureters had been catheterized before operation and there was no suspicion of such a thing as a horse-shoe kidney existing.

DR. GEORGE G. ROSS related a recent experience in kidney surgery as follows:

A woman came to him with a tumor in her right loin which had been present for 12 years. She had been operated on once with a mistaken diagnosis of gall-stones. The diagnosis of pus kidney, however, was plain. The usual incision was made and as soon as he exposed kidney, which was 10 inches long, 4 to 5 inches thick, a broad and adventitious vessel, $\frac{1}{8}$ inch in diameter, was seen going from the lateral wall into this kidney. The kidney was drained and she went on to convalescence. She left the hospital for home, got as far as Baltimore, where the

wound broke down, discharging pus and urine. She returned to Philadelphia and a second time he attacked this kidney, but again stopped at drainage. Last month he tackled it the third time. She came into the hospital with myocarditis, dyspnoea, etc., and he had her under treatment before the last operation for seven weeks. At the last operation he had loosened the kidney at its superior pole, when in twisting his finger the vena cava was torn in two and in less than a minute the patient was dead.

SPRAIN FRACTURE OF THE SPINOUS PROCESS OF THE FIRST THORACIC VERTEBRA.

DR. PENN G. SKILLERN, JR., reported the case of a man, aged twenty-two, who, while lifting a heavy object from the ground with both arms, felt something snap at the root of the neck posteriorly. He applied for treatment at the Surgical Out-patient Department of the University Hospital where he was examined by Dr. B. A. Thomas, who made a clinical diagnosis of fracture of the spinous process of the first thoracic vertebra. The signs upon which this diagnosis was based were localized tenderness, preternatural mobility and crepitus. A skiagram (Fig. 3) confirmed the diagnosis. It is noted that the spinous process of the first thoracic vertebra is displaced downward from its base of attachment to the body of the vertebra for a distance equivalent to its own diameter, so that the interspinous interval between it and the spinous process of the second thoracic vertebra on the one hand is diminished, whilst that between it and the spinous process of the seventh cervical vertebra on the other hand, is increased.

The text-books merely mention these fractures. Gurlt (Handbuch der Lehre von der Knochenbrüchen, 1862) says: "It is known that fracture limited to a spinous process is exceedingly rare." Stimson (Fractures and Dislocations, 1907, p. 145) says: "Isolated fracture of a spinous process may occur as the result of direct violence, or of *muscular action*, and the displacement is either *directly downward* or to one side. Muscular action is very rare. The spinous processes are broken most frequently at those points where they are longest and thinnest, more than one-half the cases occurring in the thoracic region: and often several adjoining ones are broken at the same

FIG. 3.



Sprain-fracture of spinous process of first thoracic vertebra. Upper arrow points to area of detachment; lower to displaced process.

FIG. 4.



"Winged scapula" in serratus magnus palsy. Arms flexed. Profile view. Position of maximum projection of inferior angle.

FIG. 5.



"Winged scapula" in serratus magnus palsy. Arms flexed. Posterior view. Note fossette just below inferior angle. Note slope of right shoulder.

time." Scudder (Treatment of Fractures, 1911, p. 92) says: "More than 50 per cent. of fractures of cervical vertebræ are fractures of the spinous processes." My case is, then, a sprain-fracture from muscular violence, most likely from intense contraction of the *thromboidei minores* muscles. Owing to the downward displacement, a pseudarthrosis is liable to ensue. Of 21 cases of complete pseudarthrosis Gurlt (*loc. cit.*) found 4 involving the spinous processes. This result is immaterial, however, and the spinous process could readily be excised.

SERRATUS MAGNUS PALSY WITH PROPOSAL OF A NEW OPERATION FOR INTRACTABLE CASES.

DR. PENN G. SKILLERN, JR., reported the case of a man, aged twenty-four, who reported at the Surgical Out-patient Department of the University Hospital, service of Dr. B. A. Thomas, October 19, 1912, complaining of inability to elevate the right arm above the shoulder.

He is an apprentice machinist, and had been working at a machine which required full reaching forward of arms 800 times a night, and to this he attributes his present trouble. He awoke one morning with pains about right shoulder which on subsiding left stiffness and the lameness of which he complains.

The patient was stripped to the waist. The eye was caught immediately by the "winged" appearance of the lower part of the scapula (Figs. 4 and 5). Seen from before there was drooping of the "point" of the shoulder (acromion). Viewed from the side the projecting inferior angle of the scapula was seen in profile behind, whilst before, with the arms elevated to the limit of their power, on the left (sound) side the lower five digitations of the serratus magnus were plainly visible, embossed in contraction between the external oblique before and the latissimus dorsi behind and were palpable as definite muscular cushions for the ribs: on the right side, however, these digitations were neither seen nor felt, and the ribs, having lost their muscular cushions, felt hard and bare. This is a sign indicative of atrophy of the serratus magnus. Behind, the scapulæ were outlined in black and the muscles inserting into them were marked on the surface with colored crayons. The inferior angle projected most when the upper extremity was flexed

sagittally to right angle, and now two fingers could be introduced into the little fossa below the overhanging angle and pushed up as far as their knuckles (2) in the subscapular fossa. A fold of skin ran downward and outward from the inferior angle which projected $1\frac{1}{2}$ inches from back. It was evident that the unopposed antagonists of the serratus magnus were responsible for the following conditions. The inferior angle had slipped from under the upper border of the latissimus dorsi owing to rotation of the scapula on an anteroposterior axis projected through its centre from contraction of the levator scapulæ and of the rhomboids, so that the acromial angle drooped from gravity and from pull of latissimus dorsi and pectoral muscles, and the lower angle was drawn enough upward and inward to release it from the binding of the latissimus. This resulted in obliteration of the triangle of auscultation and in its stead a cord-like swelling produced by shelving of the lower border of the trapezius. There was no atrophy of the supraspinatus. Elevation of the right arm beyond the domain of the deltoid was incompletely accomplished by the compensatory action of the elevator portion of the trapezius, for the occipitoclavicular and spino-acromial fibres forming its upper rounded border were strongly contracted to such extent that the head was also drawn over toward the lame side. The extremity soon became fatigued and dropped to the side.

It seemed to him that the criterion of unilateral isolated palsy of the serratus magnus must reside in the relations which the angles of the scapulæ bear to the mid-dorsal line in the various rotations of the shoulder-blades. To emphasize this he had prepared the following table.

TABLE TO SHOW RELATIONS OF ANGLES OF SCAPULÆ TO MID-DORSAL LINE IN VARIOUS POSITIONS OF THE UPPER EXTREMITIES (Distance Given in Inches.)

	Upper Angle			Lower Angle		
	R	L	Difference	R	L	Difference
(1) Resting by side	$\frac{1}{2}$	$2\frac{1}{2}$	L + 1	2	$2\frac{3}{4}$	L + $\frac{3}{4}$
(2) Flexed forward to right angle.	$2\frac{1}{2}$	$3\frac{1}{2}$	L + 1	2	$5\frac{1}{2}$	L + $3\frac{1}{2}$
(3) Abducted to right angle	2	$2\frac{1}{2}$	L + $\frac{1}{2}$	$1\frac{1}{2}$	$5\frac{3}{4}$	L + $4\frac{3}{4}$
(4) Vertical elevation	$1\frac{1}{2}$	2	L + $\frac{1}{2}$	$2\frac{1}{4}$	7	L + $4\frac{3}{4}$

From this table a graphic chart (Fig. 6) has been prepared which shows at a glance the excursions of the superior and

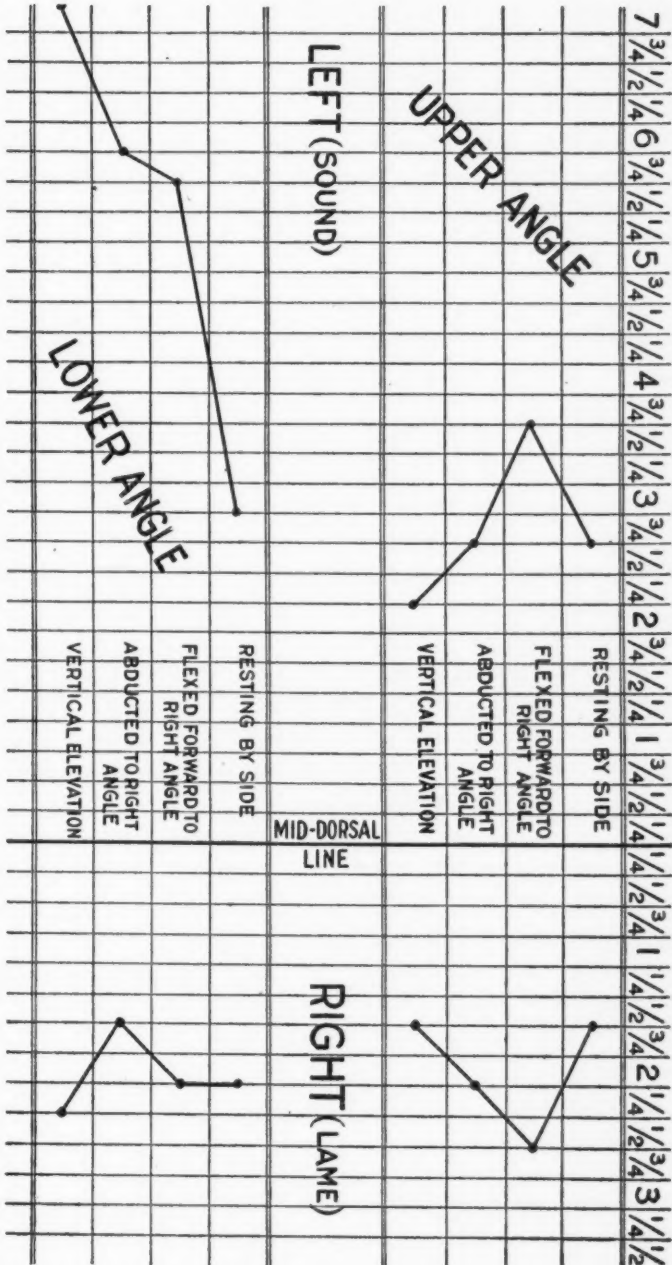


FIG. 6.

Graphic chart based upon the table showing relations of angles of scapula to mid-dorsal line in the four positions of the arm. The relations of the vertebral border to the mid-dorsal line may be figured by connecting the respective dots in the various positions. Contrast the wide forward and outward excursion of the inferior angle of the sound scapula with that of the lame.

inferior angles and most strikingly of the intervening vertebral border of the scapula from the mid-dorsal line. By connecting the respective dots on the right (lame) side it is seen that the vertebral border remains almost vertical, or parallel with the mid-dorsal line, in all positions, whilst on the left side the inferior angle is constantly carried well forward and outward with coincident increasing degrees of obliquity of the vertebral border until in vertical elevation of the limb this border forms a wide angle with the mid-dorsal line, the inferior angle reaching almost to the mid-axillary line. In fact, by actual measurement the left half of the chest from the mid-sternal to the mid-dorsal line was 16 inches, and 7 of the 16 inches, or just less than half, were traversed by the inferior angle of the sound scapula during its excursion outward and forward. The extent of the excursion of this inferior angle is not ordinarily appreciated, and the contrast on the two sides, in conjunction with the visible and palpable atrophy of the lower digitations as seen on the side of the chest, furnishes the most convincing proof that the serratus magnus is the muscle affected, and that it is pathognomonic of this malady.

With the arms folded across the back no abnormal deviation of the lamed scapula was noticeable, since here the rhomboids exercised their normal and unopposed function of adducting the vertebral borders of the scapulæ toward the mid-dorsal line and therefore toward each other.

By way of exclusion the patient was examined for progressive muscular dystrophy, so commonly localizing in the shoulder region, with absolutely negative findings. To exclude cervical rib, a skiagram was taken by Dr. Henry K. Pancoast, but no supernumerary rib was found. To exclude syphilis, a Wassermann reaction made by Dr. John L. Laird was negative. Dr. Alfred Reginald Allen very kindly made tests of the long thoracic nerve and serratus magnus muscle with both the faradic and galvanic excitors, with in both cases the reaction of degeneration.

Acting upon the diagnosis of isolated paralysis of the right long thoracic nerve of Bell due to traumatism with sequential atrophy of the serratus anticus muscle, the treatment advised was cessation from work, tri-weekly massage with passive movements, active graded gymnastics, and ascending doses of sulphate

of strychnia beginning with one-thirtieth of a grain thrice daily after meals.

After over three months of this treatment without benefit, or any sign of improvement except that gained by education of the compensatory elevator fibres of the trapezius, not wishing to discharge the patient—just entering upon his life's work—uncured and permanently crippled, an operation was advised which is believed to be original, but which has not been tried yet, pending the consent of the patient.

As to general considerations of serratus magnus palsy, Dr. Skillern said that it was not germane to the object of his communication to deal with the commoner medical and for the most part better known aspects of this malady. A comprehensive paper by Eshner (*Jour. A. M. A.*, Feb. 1, 1902) covers this ground. The literature is scarce, contributions by Gower and a monograph by Berger (1875), which covers many aspects of the subject, being the most valuable. He desired, however, to emphasize a few points which have to do with completely isolated and independent paralysis of the serratus magnus due to trauma.

In the first instance the long thoracic nerve is exposed to trauma as it traverses the scalenus medius, after emerging from which its superficial position exposes it to the pressure of objects—especially sharp-edged ones—carried upon the shoulder, particularly as is commonly seen among laborers when the object is unloaded by a short quick shrug of the shoulder. Hecker, Jobert and Fuehrer have reported cases similar to the one now reported, and in which paralysis followed heavy work that required energetic lifting of the arm in frequent repetition. Wiesner attributes the injury in these cases to violent alterations of the entire supraclavicular fossa in shape and in position.

The incidence of the malady in the present patient was similar to that in other cases in which continuous and severe action of certain scapular muscles was conspicuous in the etiology, in that it began without warning (and but slight pain) with a feeling of stiffness and weakness of the arm and then paralysis. Then the antagonistic trapezius, rhomboids and levator scapulæ, now unopposed and free to act, contracted and produced the above-depicted deviation of the scapula, whilst the serratus magnus, freed from its taskmaster—the long thoracic nerve—lay dormant and slumbering and shrivelling up upon the chest-wall. The

seeming elevation of the lame arm higher than the shoulder is more apparent than real, and is very weak and wavering, it being due as aforementioned to compensatory action of the elevator (spino-acromial) portion of the trapezius.

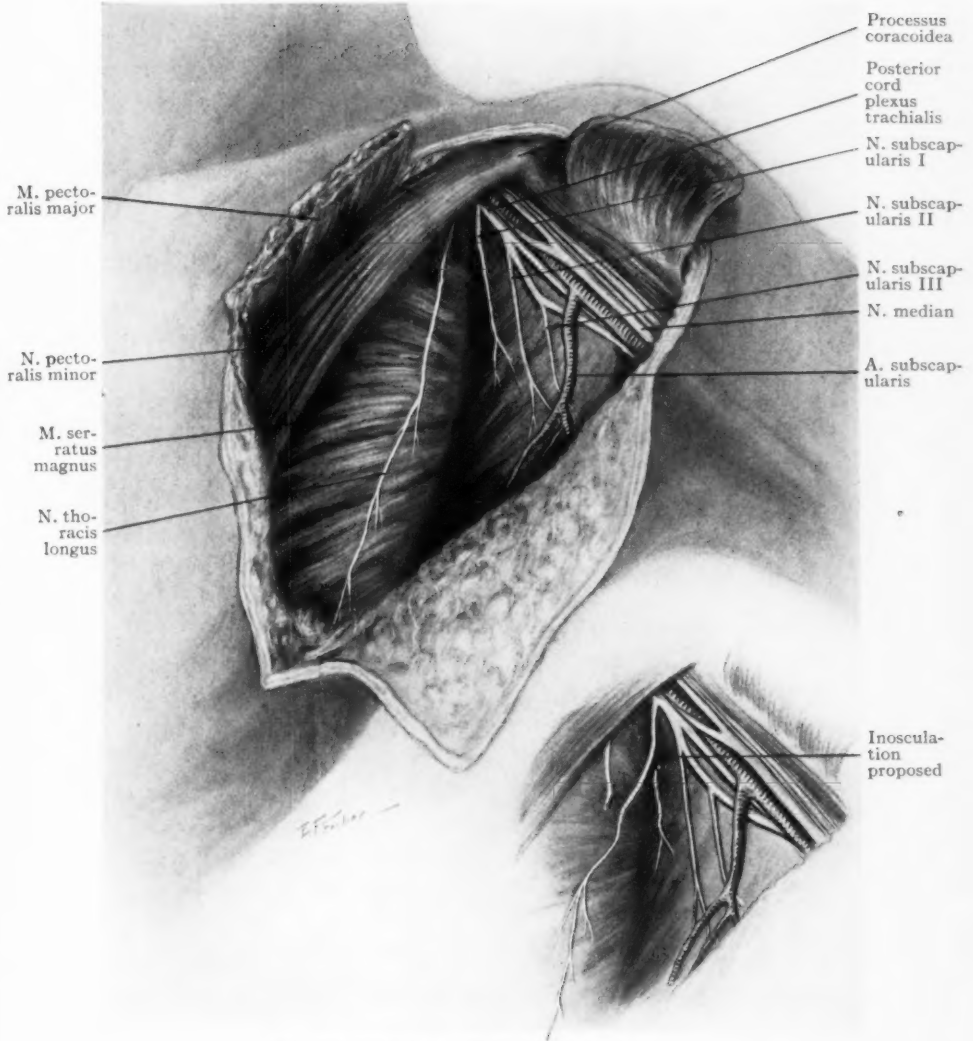
Conservative measures are being thoroughly tried out in this patient because he reported early for treatment, and the earlier a case is treated with electricity the more favorable are the chances for its restoration. Again, experience with similar cases by others has shown that those cases are apt to heal in which an overstretching of the shoulder muscles is at the bottom of the palsy, and also complete restoration has been produced by the faradic current in cases that have existed many years. With these measures he may expect a certain degree of improvement, but in all probability a permanent lameness of the arm with the characteristic deformity.

The prognosis, however, must not be based so much upon the behavior of previous similar cases as upon that of the case that confronts us. It depends upon the severity of the anatomic lesion of the nerve, the nutritional state of the paralyzed muscle, and the extent of secondary changes in its antagonists. Further, complete absence of reaction of the nerve and muscle to both currents makes the prognosis absolutely bad and almost always means the case is incurable.

The crux of this case is the textural condition of the long thoracic nerve, and of the four possibilities,—concussion, compression, contusion and laceration—the probability, based upon the clinical findings, is laceration with separation and with interposition of scar tissue between the dissevered ends. This being the case, no amount of electricity, massage or other measures will remove that scar tissue. The lesion is on a small scale akin to traumatic rupture of the brachial plexus and should be dealt with accordingly. It is for these reasons—and mainly to restore a useful arm to this man entering upon his wage-earning life—that Dr. Skillern has planned and recommended the execution of the following operation.

Operation.—It is evident that the only operative procedure to be considered here is that of inosculating the proximal end of a healthy nerve to the distal end of the injured long thoracic. In casting about for a nerve that would fulfil the requirements of equal size, identical origin and close proximity, it occurred

FIG. 7.



Proposed operation for serratus magnus palsy.

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to him that choice lay between the three subscapulars. Of these the uppermost is the shortest, and, passing down behind the axillary artery, soon sinks into the subscapularis, which it supplies. Its origin from the fifth and sixth cervical nerves is almost identical with that of the long thoracic, which arises additionally from the seventh. Its size is equal to that of the long thoracic and its proximity is close, it being but one-half inch behind and to the outer side (Fig. 7). It usually consists of two branches, an upper and a lower. Thus it is possible for one branch of the upper subscapular to be preserved to dominate the upper portion of the subscapularis, the lower portion receiving its innervation from the lower subscapular which supplies, in addition, the *teres major*. The middle or long subscapular continues its lengthy course to the *latissimus dorsi*. The short subscapular nerve, therefore, is the least important of the three, supplies only part of the subscapularis, and fulfils the conditions.

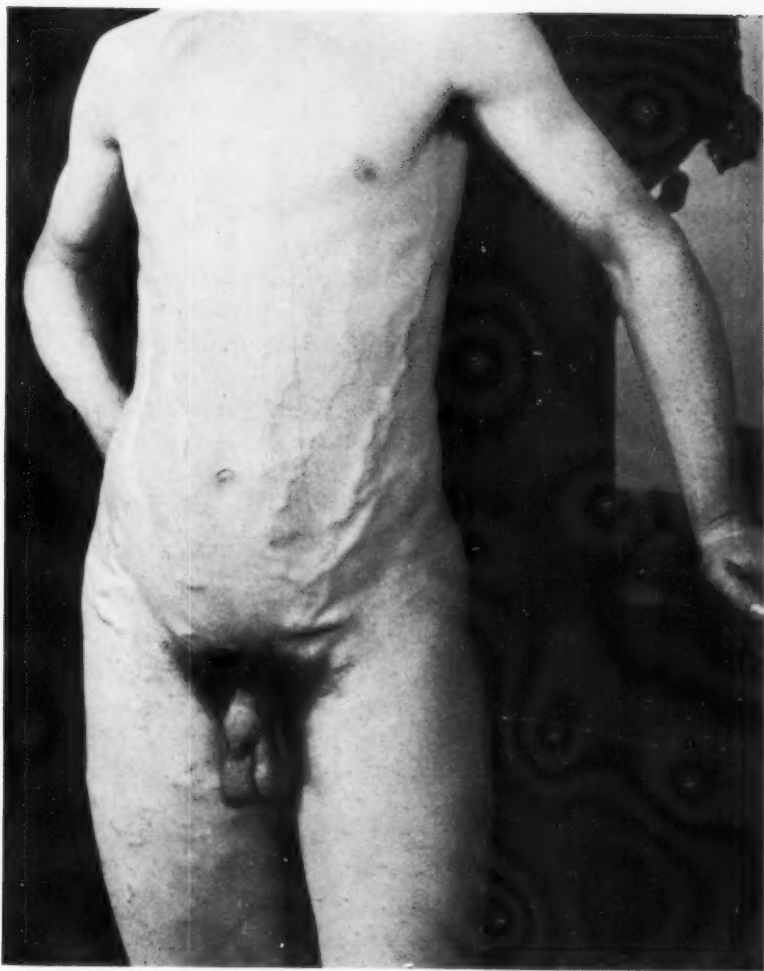
A horseshoe-shaped flap is outlined over the hollow of the axilla with its base corresponding to the anterior fold (lower border of the *pectoralis major*). The flap, including the underlying axillary fascia, is raised and reflected over the anterior wall. The long thoracic nerve is sought for coursing down the middle of the inner wall of the axilla, beneath the fascia covering the *serratus magnus*. It is traced up to the apex of the axilla, beneath the great neurovascular bundle, which is retracted forward against the anterior axillary wall. The posterior cord of the brachial plexus will thus be stumbled upon, it being the lowest constituent of our upturned neurovascular bundle. The three subscapular nerves are readily seen coursing beneath the fascia upon the subscapularis and are traced up to the posterior cord. The uppermost of the three is now found but one-half inch from the long thoracic. It is approximated to the long thoracic, both are severed, and the proximal portion of the short subscapular united in contact end-to-end, with the distal portion of the long thoracic, using very fine catgut suture. The line of union is wrapped about with egg-membrane in order to prevent interference by connective-tissue from without, and to facilitate regeneration of the neurilemma tube.

ULTIMATE OUTCOME OF SUPERFICIAL COLLATERAL CIRCULATION IN A CASE OF POST-TYPHOIDAL THROMBOPHLEBITIS OF THE INFERIOR VENA CAVA.

DR. SKILLERN gave the later history of a case which was first reported in detail in the ANNALS OF SURGERY (1912; lv; 6; p. 919) and the condition of the superficial abdominal veins at that time is reproduced in the accompanying cut (Fig. 8). They have been present ever since an attack of typhoid fever, three years ago. Several months ago, following immediately an attack of acute tonsillitis, the patient noticed that the veins over the right half of the anterior abdominal wall had become reddened and painful. Examination at this time revealed acute thrombophlebitis with its classical picture of a broad streak of dusty redness, swelling, local heat, tenderness, and cord-like tenseness of the superficial veins over the right half of the anterior aspect of the trunk between the right inguinal furrow and the axilla. After a few days of treatment by rest in bed, catharsis, mercury thrice daily, and local applications of lead-water and alcohol, the acute phlebitis subsided, leaving small thrombi here and there along the course of the veins, and shortly afterward these thrombi disappeared and no trace of any dilated veins could be seen (Fig. 9). After this the same process was repeated on the left side, likewise resulting in disappearance of the veins, with the exception of the lower part of the thoraco-epigastric vein just above the middle of left Poupart's ligament. This had always been the largest and most tortuous vein, and a hard thrombus remained in it.

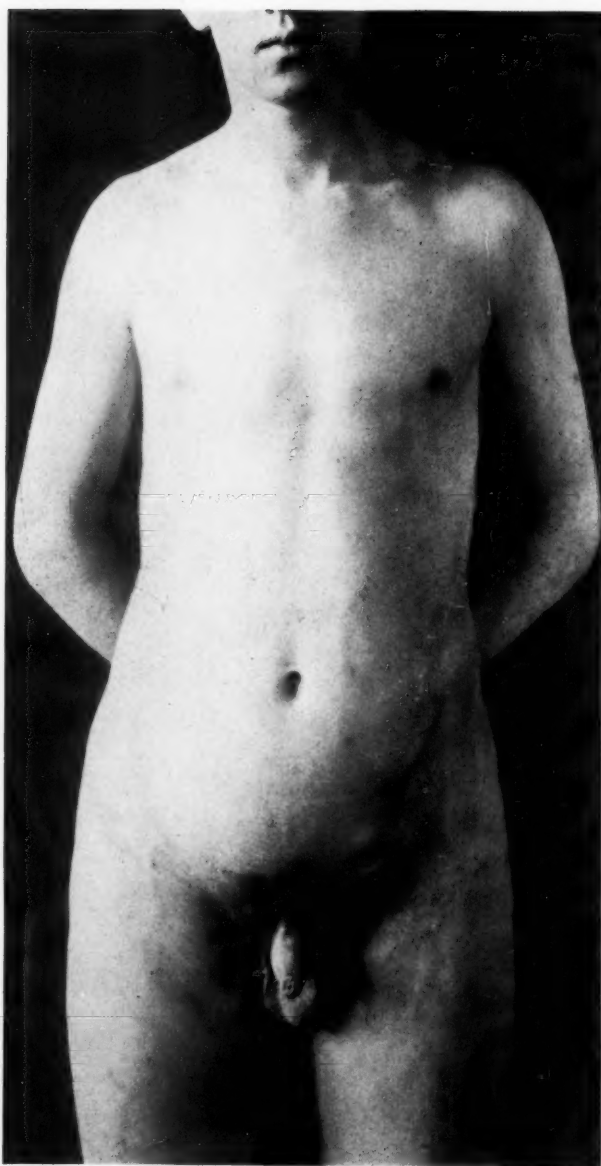
The pathology here seems to be clearly explained by metastatic infection of the chronically-congested vasa vasorum by bacterial emboli carried by the blood-current from the primary focus in the tonsil to the *locus minoris resistentiæ*. The minute thrombi arising from its bacterial invasion of the vasa vasorum migrated by continuity into the larger dilated and weakened superficial veins, whose walls they nourished, and gave rise to the macroscopic acute thrombophlebitis, which later extended over to the left side more likely through the superficial than the deep veins, for had the common iliacs been invaded there would have been milk-leg, which did not arise. During the temporary occlusions of these veins by the thrombi the blood current was forced into the deeper para-vertebral channels,

FIG. 8.



Enlargement of superficial veins consequent upon occlusion of the vena cava inferior.

FIG. 9.



Subsidence of enlarged superficial abdominal veins three years after acute metastatic thrombophlebitis occluding inferior vena cava.

which dilated to accommodate the extra volume of blood, and after the subsidence of the superficial phlebitis they remained permanently dilated and kept on returning the extra blood, whilst the superficial veins contracted from the fibrous tissue which organized the thrombi. It seems scarcely necessary to theorize upon a coincident canalization of the thrombus in the vena cava for there were no signs of deep thrombophlebitis. The crural ulcers seemed to be healing.

LUXATION AT MIDTARSAL (CHOPART'S) JOINT.

DR. SKILLERN presented skiagrams showing a midtarsal dislocation. This history was as follows: A negro man, aged twenty-three, presented himself at the Surgical Out-patient Department of the University Hospital, service of Dr. B. A. Thomas, on June 20, 1912, complaining of an injury to his right foot received the previous day in the following manner: While standing upon two iron beams with the heel on one, the ball on the other, and the arch spanning the intervening space, a third iron beam fell from a freight car four feet above upon the dorsum of the right foot. Examination revealed great swelling, which obscured bony landmarks upon the dorsum; tenderness over the astragalo-scaphoid joint internally, but more marked over the calcaneo-cuboid joint externally; and loss of rotatory movement but preservation of flexion and extension. There was no ecchymosis. Skiagram, taken by Dr. Henry K. Pancoast (Fig. 10) showed incomplete total luxation at midtarsal joint with sprain-fracture of antero-external corner of os calcis. The patient, a negro, refused an anæsthetic, but by manipulations somewhat similar to those used in the reduction of Colles' fracture, he restored the articular surfaces by plantar flexion followed by extension and rotation outward, and applied a gypsum case (Fig. 11).

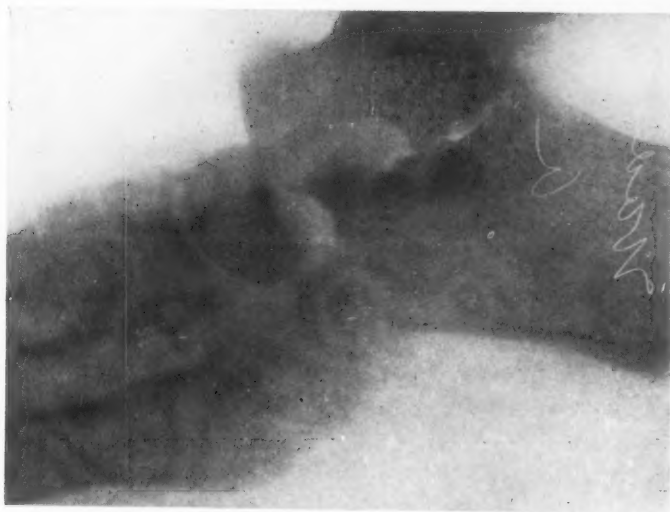
The reporter remarked that Petit (*Oeuvres complètes; Bibliothèque Chirurgicale*; 1837; I; p. 98) described the first two cases of this injury, but his as well as Sir Astley Cooper's (*Treatise on Dislocations and Fractures*; 1823; p. 376) cases were severely criticized by Broca (*Mémoires de la société de chirurgie*; T. III; 1853; p. 566) as having been based on insufficient evidence. Malgaigne (*Traité des Fractures et des Luxations*; 1855; II; p. 1071) was the first to name the injury mid-

tarsal luxation. In a very extensive monograph Houzel (*Thèse de Paris*, 1911) reviewed the literature up to 1911, and went into the minutest detail concerning the mechanism and other features. He alleged to have found 34 cases. At about the same time, however, Paul Mueller (*Fortschr. a. d. Geb. des Röntgenstrahlen*; 1911-1912; XVIII; p. 187) sifted the literature much more carefully, selecting those cases only which had been confirmed by skiagram or by autopsy. With these provisions just 12 cases, including one of his own, passed muster. Goebel (*Archiv. f. Orthop.*; 1912; XI; p. 9) thought to add one more to this last, but his case must be omitted from classification because it was almost a pure dorsal double luxation of the scaphoid, which carried with it the internal cuneiform alone, instead of the entire forefoot. The present case, therefore, is the thirteenth instance of this rare injury.

Corson (*ANN. SURG.*, 1912; LVI; 6; p. 883) gives a discourse without conclusions about "Mediotarsal Subluxation as Shown by the X-ray," and examination of the skiagrams shows that the first was taken with the foot in plantar flexion,—a position we employ in surgical anatomy to make prominent the head of the astragalus as a bony landmark upon the dorsum of the foot, and also in a Chopart amputation to facilitate entrance of the scalpel into the dorsum of the joint. Corson was deceived by the natural widening of the joint-line under these circumstances, for the next skiagram (after reduction (?)) shows the foot at right-angle to the leg, in which position the joint-line is reduced to a chink.

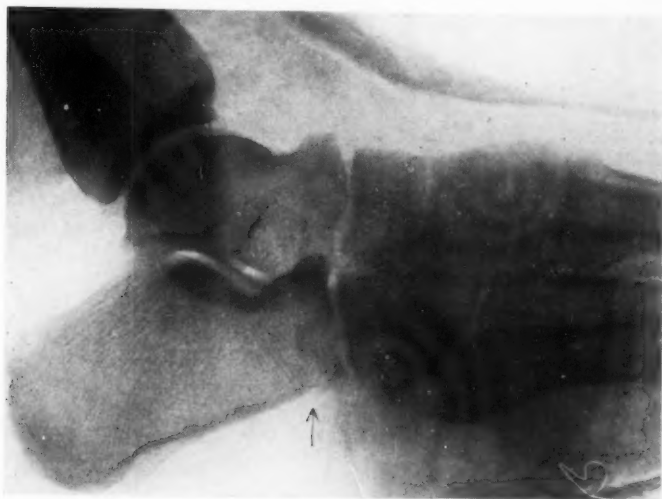
The midtarsal or Chopart's joint, more recently well-designated by Fick the "transverse tarsal joint," is formed by the os calcis and astragalus behind articulating, respectively, with the cuboid and scaphoid before. The calcaneo-cuboid joint is firmly bound by the long and short plantar ligaments supported by the tendon of the peroneus longus, so that its mobility is reduced to a minimum. At the astragalo-scaphoid joint a composite socket is formed for the head of the astragalus by the sustentaculum tali behind, the scaphoid before, and in between by the upper cartilaginous surface of the inferior calcaneo-scaphoid ligament, which is short and very thick and one of the strongest in the body. This ligament as well as the joint is stoutly supported by the inserting tendon of the tibialis

FIG. 10.

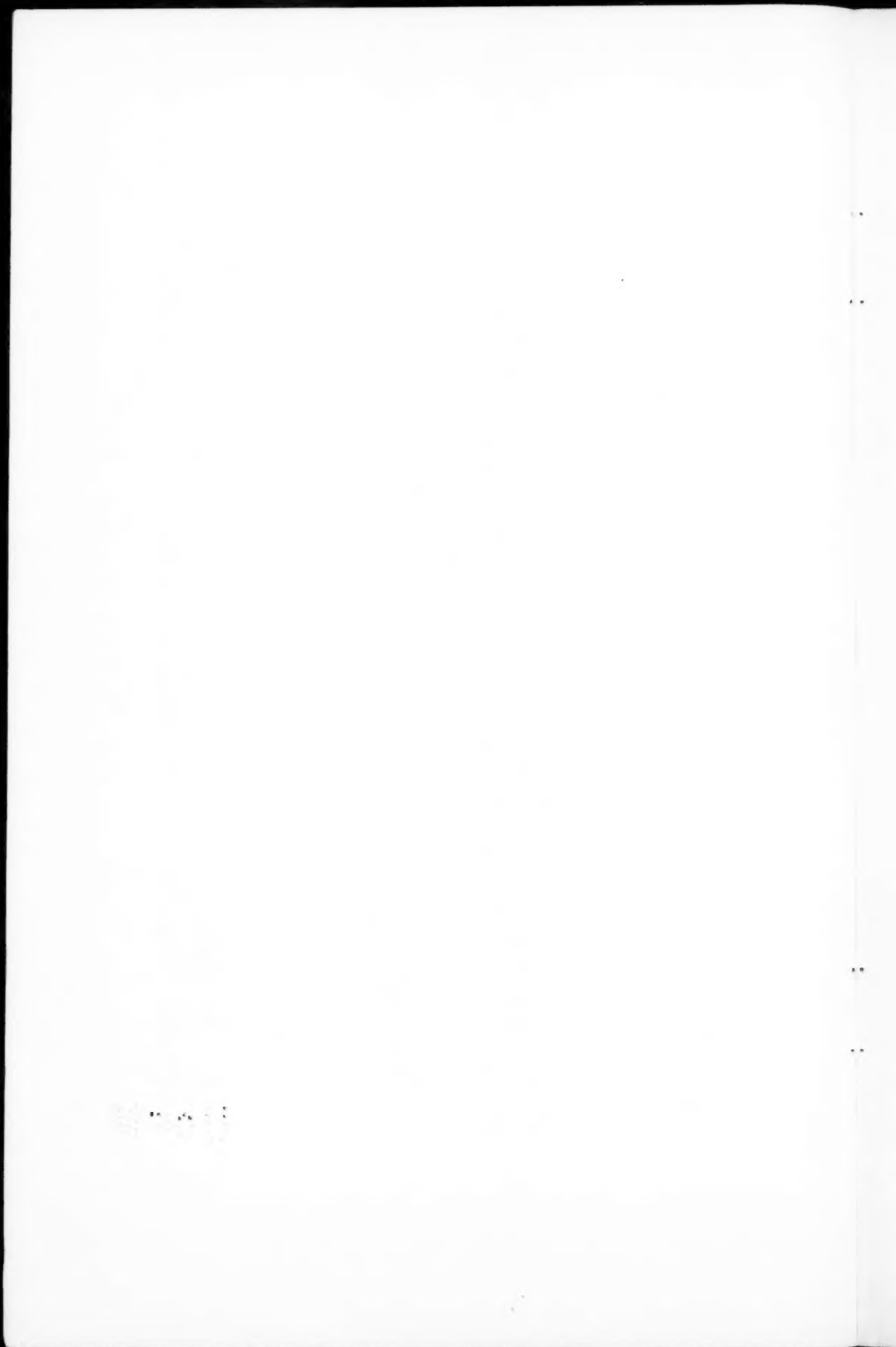


Luxation at mid-tarsal joint, before reduction. *Type*—total incomplete plantar. Note prominence of head of astragalus on dorsum.

FIG. 11.



Luxation at mid-tarsal joint after reduction. Gypsum case applied so as to support antetarsus but permit posterior tarsus to sink. Note sprain-fracture of os calcis.



posticus. The astragalo-scaphoid joint is higher and more exposed than the calcaneo-cuboid, and its range of motion greater. It is the opposition joint of quadrupeds but has lost this significance in man, its most important function being to supplement or accompany movements of the ankle-joint. The combined units of the transverse tarsal joint furnish motions of slight plantar flexion and slight rotation about the longitudinal axis of the foot. Otherwise the tarsus has practically no mobility. The part of the foot in front of this joint-line may be referred to as the antetarsus, and that behind, the posterior tarsus.

Luxation here may be classified according to the involvement of one or both joints as partial or total; according to the extent as complete or incomplete; and according to the direction as plantar or dorsal. The present case, therefore, classifies as a total, incomplete luxation of the plantar type. It is total because both joints are involved; it is incomplete because the articular surfaces are still in contact inferiorly; it is of the plantar type because the antetarsus is lowered into the sole of the foot. Isolated luxation of the calcaneo-cuboid joint never occurs, but is precipitated by the astragalo-scaphoid joint taking the initiative, just as one mountain-climber is dragged down by another who has lost his foothold. There is usually a lateral displacement, in addition.

Predisposing causes are repeated sprains which relax ligaments, and pathological states, notably flat-foot and pigeon-toe. Determining causes are direct violence (as in this case) but more commonly indirect, usually when the foot is in hyper-extension (plantar flexion) at the time of trauma.

The subjective symptoms are pain and loss of function; the objective signs, much swelling, alteration in bony landmarks, and shortening between tibial malleolus and hallux. In the dorsal type the scaphoid (if partial) and, in addition, the cuboid (if total) are shoved up to project onto the dorsum to an extent varying with the completeness of the luxation, whilst in the sole the anterior extremity of the os calcis as well as the head of the astragalus form prominences. In the plantar type which is more frequent, this state is reversed, the cuboid and scaphoid projecting into the sole, obliterating the arch and giving rise to a prominence in the centre, which is readily seen in a plantar

imprint, whilst on the dorsum the head of the astragalus and anterior extremity of the os calcis form prominences over which the extensor tendons course just as the bridge of a violin raises its springs.

The diagnosis is based upon the clinical findings in conjunction with the skiagram. If great swelling interferes with a satisfactory examination, the lesion may be *suspected* and diagnosis made by skiagram.

As associated lesions there may be sprain fracture of adjacent tarsal bones; compression-fracture of the os calcis; compounding through the skin; and from the great swelling and hemmed-in extravasation thrombosis followed by gangrene of the foot and leg. Late lesions, especially if unreduced, are tarsitis with osteophyte formation, retraction of tendons and muscular atrophy. The prognosis is good after proper reduction.

Treatment consists in immediate reposition, preferably under anæsthesia. The posterior tarsus is immobilized and the antetarsus manipulated according to the variety of the luxation so as to retrace its emergent path. It is a matter of judgment and patience. Vanverts thus succeeded in reducing a luxation of two weeks' standing.

Some cases are irreducible at the outset. For these and for poorly-functionating old cases operation is indicated. Even at operation there may be considerable difficulty in locating the obstacle to reduction. In old unreduced cases with poor functional result the operation of partial anterior tarsectomy, in which the scaphoid alone is removed, reduces the luxation and re-establishes the arch.

After reduction by either bloodless or operative measures regard must be had for the weakened plantar arch. In the present case a gypsum case was applied immediately after reduction and three weeks later a flat-foot shoe. He was a poor risk against flat-foot both because of his race and because of weakening of the calcaneo-cuboid joint from sprain fracture of the inferior articular edge of the os calcis from the pull of the important plantar ligament.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

*Stated Meeting, held at the New York Academy of Medicine,
February 12, 1913.*

The President, DR. CHARLES L. GIBSON, in the Chair.

BILATERAL TEMPOROMAXILLARY ANKYLOSIS.

DR. HOWARD LILIENTHAL presented a boy, eight years old, who was admitted to the Mt. Sinai Hospital on January 11, 1913. Two years ago he had scarlet fever, and about fourteen months before admission he began to have difficulty in opening his mouth. This had progressed, and when he was admitted to the hospital he could separate the jaws only about one-third of an inch, when there was a sharp, mechanical bar to further action. His face was normally developed, lacking the bird-like deformity which occurred from arrest of development of the jaw when the locking had lasted for years. There was slight asymmetry of the mouth, suggestive of facial nerve disturbance. An X-ray of both sides of the face proved extremely difficult to interpret, although it appeared that the condyle on the left side, at least, was present. On the right side nothing could be made out excepting a mass of new bone which obliterated the landmarks.

On January 13, under anæsthesia, Dr. Lilienthal attempted to forcibly dilate the jaws with a wedge, but this proved impossible. and after the attempt the jaws were completely locked. Four days later the boy was again etherized, and an operation was performed according to the method which the speaker had published in the ANNALS OF SURGERY for August, 1911. An incision was made along the zygoma down to the bone, and a second incision, at right angles to the first, was made through the skin only. After dissecting up the skin flap, the zygoma was

cut with an osteotome or saw, and the loose piece of zygoma with its attached masseter, the fat, and ramifications of the facial nerve were pulled down. This gave excellent access to the sphenomaxillary fossa. The idea of the operation was to avoid absolutely the facial nerve, which no other operation would do.

In this case, Dr. Lilienthal said, the chisel had to be used instead of the Gigli saw, and a portion of each zygoma had to be sacrificed. On the left side, the condyle was still covered with smooth cartilage, although there was dense exostosis from the inner aspect of the zygoma, impeding motion. The overgrowth of bone filled the glenoid fossa and embraced the condyle. All of this new bone was removed, but the neck of the mandible was not cut through. In removing the exostosis with the chisel, the cranium was opened at one point so that the dura was exposed. On attempting to separate the teeth, it was found that little if anything had been gained, and the right side was immediately attacked. Here the overgrowth of bone completely hid all the landmarks, so that orientation excepting of the roughest kind was impossible. A wide resection of the neck and part of the ramus of the jaw was here performed, after most of the new bone had been removed with chisel and gouge. Immediately there was free mobility, so that the teeth could be separated for more than an inch. The vertical incision was then extended, and a flap of temporal fascia with the attached fat was mobilized and inserted between the moving parts and held in position by a suture. The left side was again exposed and the same procedure repeated, omitting, however, the extension of the incision.

For some days after the operation there was great swelling of the face, and some slight infection of the wound. A large cork was held between the teeth so as to prevent immediate contraction, but in a few days after the operation the patient could open and close his mouth perfectly. He was still compelled to wear the cork for some hours each day, and this would have to be continued for at least a year. The wounds were now completely healed, and function was excellent.

Dr. Lilienthal said this was the fourth case of ankylosis of the jaw that had come under his observation. In two of these the deformity was due to scarlet fever. In the two others it was due to fracture of the neck of the jaw on each side. In three out of four cases where he had done this operation, it had proven

perfectly successful; in the fourth the operation was a secondary one, which rendered it more difficult, and that patient was still under treatment.

UNILATERAL RENAL HÆMATURIA.

DR. EUGENE H. POOL presented a man, forty-nine years old, married, who came to the French Hospital on October 28, 1912, complaining of passing very red urine, and of weakness. These symptoms were of about two months' duration. There was no pain. The patient stated that up to two years ago he had suffered from frequent nose-bleeds. He denied venereal infection and his habits were good.

Upon inspection, the patient did not appear very ill, although his skin had a peculiar brownish discoloration, which he said was his natural color. The lungs were negative; the heart gave a systolic murmur at the apex. The kidneys were not palpable; the knee-jerks were exaggerated. Upon cystoscopic examination, the bladder wall, trigone and ureteral openings were apparently normal. Both ureters were catheterized and found patent. A dark red fluid was secreted from the left ureter; an amber-colored fluid from the right. Upon examination, the secretion from the left ureter was found to be loaded with blood-cells and a trace of albumin; no casts. That from the right ureter showed normal urine. The von Pirquet, Wassermann and X-ray tests were all negative. There were no tubercle bacilli in the urine. The indigo-carmin test showed that both kidneys were functioning equally and normally.

The diagnosis of essential hæmaturia was made on account of the normal appearance of the bladder wall, the absence of pus and casts in the urine, the negative X-ray findings, the absence of pain and tumor; the failure to find any etiological factor to account for the blood in the urine. However, the age of the patient and the short duration of the bleeding made it impossible to exclude neoplasm, and for that reason rather than to check the hemorrhage operation was deemed advisable.

Operation, November 12, 1912: The left kidney, upon exposure, appeared approximately normal in size and contour. Its surface was studded with a number of dark, bluish areas of various sizes, with the normal color of the kidney showing between them. To decrease the danger of hemorrhage and avoid

injury to the kidney, pyelotomy was done instead of nephrotomy, and a mass of semisolid dark red material, which filled the entire pelvis, was removed. On immediate microscopic examination, this proved to be fibrin. The kidney was then explored with the finger passed into its pelvis and nothing abnormal could be felt. The kidney was then decapsulated since the hæmaturias of unknown origin or nephritic origin have been frequently benefited by this procedure. A small piece of kidney cortex was removed for microscopic examination. The wound was then closed, with drainage.

The post-operative course of the case was uneventful. The blood in the urine gradually diminished, and on December 27, six weeks after the operation, the centrifuged urine showed but a few red blood-cells. There was thus a slow rather than a rapid cessation of the hemorrhage. On January 15, 1913, there was no further bleeding, and the patient improved markedly in health. Within the past few days, however, a small amount of blood was again present in the urine.

The pathological report, made by Dr. Hughes Dayton, was as follows: The specimen consists of a section of the cortex and part of the medullary rays of the kidney. The capsule was irregularly thickened, and large and small bands of connective tissue extended from it between the tubules of the cortex. There was marked connective-tissue infiltration of large areas of cortex. There were extensive patches of round-cell infiltration of the cortex, involving also the tips of the medullary rays. Some of the glomeruli showed an increased number of nuclei, while the capsules showed proliferation of the connective tissue. The tubules, in the areas of marked connective tissue increase, were much contracted: in the cortex, some of the tubules contained hyaline casts, with adherent leucocytes; a few contained masses of leucocytes. Some arched and straight collecting tubules contained masses of red cells and brownish pigment. Diagnosis, chronic interstitial nephritis (with hemorrhage into collecting tubules).

In connection with this case Dr. Pool said that much had been written in recent years about a certain unusual type of renal hæmaturia, and that while some writers had claimed that a so-called essential hæmaturia might occur without any demonstrable lesion, the prevailing opinion appeared to be that there was always a lesion to account for the hemorrhage. If this is true, the term

"essential hæmaturia" is misleading. However, while uncertainty on this point prevails, the term "essential hæmaturia" should be restricted to those cases in which no lesion, either gross or microscopic, can be found. In the case Dr. Pool had shown, which before operation was regarded as one of essential hæmaturia, a lesion of the kidney was subsequently demonstrated, namely a chronic interstitial nephritis.

DR. LILIENTHAL said he had operated on a similar case about a year ago. The patient was a young man, a medical student, who for several years had suffered from hemorrhage from the kidneys, and upon a cystoscopic examination on three different occasions, blood was found coming from the left kidney. There were no evidences of nephritis. For the same reasons as those given by Dr. Pool, and particularly to exclude the presence of a new growth, especially hypernephroma, a nephrectomy was advised. Upon exposing the left kidney, it appeared to be perfectly healthy, and after its removal it was examined by Dr. F. S. Mandlebaum, who made a minute pathological examination and was unable to demonstrate any lesion. That was a case, apparently, of undoubted essential hæmaturia. The young man had remained perfectly well up to the present time.

SUPPURATIVE PYELITIS: NEPHROLITHIASIS: NEPHRO-URETERECTOMY.

DR. LILIENTHAL presented a man, thirty-five years old, who came under observation on April 9, 1912, with the history of a number of attacks of urethritis, the first one fifteen years ago. He had lues seven years ago, which was apparently cured, as evidenced by a negative Wassermann. Five years ago he had his first attack of renal colic, followed by several others. His chief complaint was that he suffered from pain in the suprapubic region, which was aggravated on walking. He urinated twice during the night. The urine contained large quantities of pus and a few red blood-cells. He had been treated for some time by a genito-urinary specialist, who had done a cystoscopy but did not catheterize the ureters. The opinion of this specialist was that there was no calculus, and that the patient's symptoms had their origin in the deep urethra and trigone. The mouths of the ureters were said to have had a normal appearance, and to have emitted clear urine.

Upon Dr. Lilienthal's suggestion, a radiogram was made by

Dr. L. Jaches, which showed a large stone in the pelvis of the right kidney. On April 23, Dr. Lilienthal catheterized the ureters, passing easily into the left normal ureteral orifice and withdrawing clear urine. On the right side, the catheter was arrested at one and a half cm., and drew no urine. The mucosa around the right ureteral orifice was injected and oedematous. The urine from the left kidney showed nothing abnormal.

On April 24 the usual transverse incision was made over the right kidney, and after resection of the twelfth rib the kidney was delivered, but not without considerable trouble, owing to dense adhesions around the pelvis of the organ. A nephrectomy was at once performed, and the vascular pedicle ligated with silk, the adhesions preventing the isolation of the individual vessels.

The specimen, on section, showed marked fatty degeneration, and a single, large rough calculus in the much dilated pelvis. The ureter was the size of an adult thumb, and its walls were greatly thickened. Believing that the thickening and dilatation were due to stricture at its vesical termination, Dr. Lilienthal removed the entire ureter by the method he had described in the *ANNALS OF SURGERY*, April, 1911. Both wounds were drained and healing was prompt, excepting at the site of the silk ligature surrounding the pedicle, which still protruded from the wound in the loin at the time of the patient's discharge, about five weeks after the operation.

Barring a tendency to alkalinity of the urine, which was kept in check with the help of urotropin and benzoic acid, this patient now enjoyed good health.

TUBERCULOSIS OF THE KIDNEY AND URETER: NEPHRO-URETERECTOMY.

DR. EUGENE H. POOL presented a woman, a trained nurse, twenty-three years old, who for four weeks prior to her admission to the hospital was troubled with frequent painful attacks of hæmaturia. Three years ago and at intervals since then she had had similar attacks. Otherwise, she had always been well and strong.

A cystoscopic examination, made by Dr. Benjamin S. Barringer, showed a much congested bladder wall, with ulcerated areas in the region of the trigone. The right ureteral orifice was apparently normal; the left was surrounded and overhung by

polypoid-like growths. The cystoscopic picture was that of a tuberculous cystitis.

Both ureters were catheterized, with the following result: right, 30 c.c. of urine, containing a few leucocytes and 17 grams of urea to the litre. Left, 3 c.c. of urine, containing a small amount of pus and $3\frac{1}{2}$ grams of urea to the litre. The indigo-carmin reaction appeared from the right kidney half an hour after injection; from the left, two hours. Practically all the indigo-carmin was excreted by the right kidney.

A nephrectomy was done by Dr. Pool about six weeks ago. The left kidney was found considerably enlarged and distended with pus. The upper end of the ureter did not appear to be much involved, but on account of an experience which he had several years ago, the speaker said he decided to remove it. In the case referred to he had removed a tuberculous kidney, leaving the ureter, which apparently was not involved. Some months later, Dr. Alexander B. Johnson operated on the same patient, removing a very large tuberculous ureter. (*ANNALS OF SURGERY*, vol. liii, 1911, p. 563.)

Having this experience in mind, Dr. Pool said, he removed the ureter in the present case, following the method described by Dr. Howard Lilienthal. Through a three-inch incision close to and parallel to Poupart's ligament and mesial to the anterior spine, the ureter was very easily removed extraperitoneally, a vertebrated sound having been first passed into it from above. The ureter was identified by palpating the sound and then easily exposed and freed for a short distance by sight; it was then an easy matter to separate the rest by touch. In treating the stump, he cut it half way across, using the upper end as a handle, cauterizing the lower end with the actual cautery and ligating it before it was completely severed. Most of the ureter was considerably dilated, its walls were thickened, and sections taken from several parts, including the lowermost, showed marked tuberculous involvement.

Both wounds healed readily and the patient was discharged in 23 days. Her weight and health had considerably improved since the operation, and the speaker said he could commend Dr. Lilienthal's procedure as extremely useful and simple in a primary nephrectomy.

DR. LILIENTHAL said he had tried at various times to bring

this method of extirpating the ureter before the profession, but for some unknown reason surgeons seemed to be content with taking out the kidney and leaving the tuberculous ureter, perhaps filling it with carbolic acid and if necessary removing it at a subsequent operation. It has been demonstrated that in tuberculosis of the kidney the vesical end of the ureter was apt to be diseased or likely to become so. By the method he had described the ureter could be removed in a very few minutes—perhaps ten or fifteen—and the patient was then freed, once and for all, of the entire tuberculous focus.

DR. CHARLES N. DOWD said he had resorted to this procedure, as described by Dr. Lilienthal, and had found it very simple and easy, and very much more satisfactory than the removal of the ureter at a secondary operation.

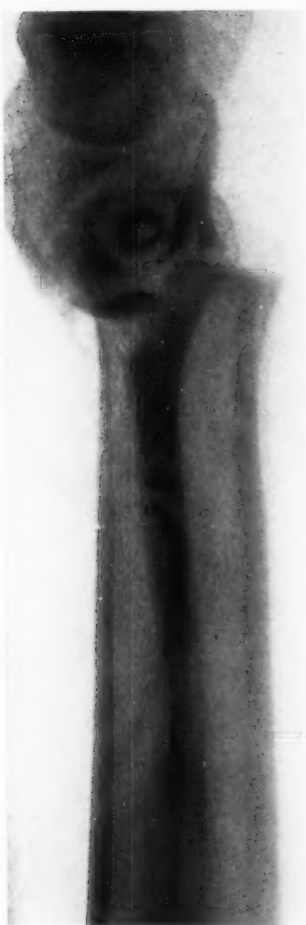
DR. POOL said that in addition to the fact that the removal of the ureter in such a case was a very rapid and easy procedure, it should be emphasized that this only held good at the time of the primary nephrectomy. In a secondary nephrectomy it was apt to be very difficult to expose and free the upper part of the ureter, therefore the method was scarcely applicable to such cases.

HABITUAL FORWARD DISLOCATION OF THE HEAD OF THE ULNA.

DR. WILLIAM DARRACH presented a man, twenty-one years old, a chauffeur, who had come to Roosevelt Hospital two days ago with the following history: Eleven months before he had received a back-kick while cranking an automobile, the crank-handle remaining in his hand. This injury, as shown by the X-ray, produced a fracture of the radius one inch above the articular margin, together with a fracture of the ulnar styloid. Three and a half weeks later he returned to work with a strong and useful wrist. Twelve weeks later the radius was refractured at the same point from a similar cause. Attempts at reduction at this time were less successful, the lower fragment maintaining its dorsal displacement. X-rays taken before and after these attempts, however, showed an abnormal mobility of the head of the ulna. Massage was begun on the fourteenth day, and after three and a half weeks he was able to use the wrist without any apparent impairment of function.

Six months after the second injury the patient was thrown

FIG. 1.



After second injury.

FIG. 2.



Showing the way nature has tended to obliterate the deformity.

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from a car and again injured his wrist, which was moderately swollen and slightly painful for a few days. Since the receipt of this injury, when he completely supinated the hand or pushed anything with it, he felt something slip out of place in the region of the head of the ulna. Excepting for his inability to use the pliers and a slight decrease in power, this interfered but little with his work.

On examination, the right wrist was a little wider than the left, and showed a slight silver fork deformity, but without radial shifting of the carpus. On supination, the dorsal prominence of the ulnar head disappeared, leaving a depression. In this position, the dorsal portion of the sigmoid cavity of the radius could be felt. On pronation, the ulnar head could be felt to slip back into place, but it could readily be pushed backward and forward. It could not be separated laterally from the radius. An X-ray, taken two days ago, eleven months after the original injury, showed the ulnar styloid to be still ununited, and a persistence of the backward curve of the radius due to the imperfect reduction of the dorsally displaced lower fragment. An interesting feature of the case was the beautiful way in which nature had rounded off the projecting lips. In this case there was apparently a forward dislocation of the head of the ulna associated with the second fracture, if not also with the first. This had evidently healed, but the strain on the front of the capsule and the triangular ligament due to the dorsally displaced lower radial fragment was such that the third injury tore the ulnar head loose from its attachments. (Fig. 1.)

Dislocations at the lower radio-ulnar articulation, Dr. Darrach said, might be uncomplicated or associated with fracture of the lower radius. The ulnar head may pass dorsad or ventrad, and in the latter case may be pulled outward, so as to lie ventral to the radius. Of the ventral dislocations, unassociated with fracture of the radius, Cotton¹ has collected 27 cases from the literature, to which he has added one. This list could be further increased by the case shown by Hitzrot² in January, 1912, by the case shown by Darrach³ in May, 1912, and by three others reported

¹ Cotton: ANN. OF SURG., March, 1912, lv, p. 368.

² Hitzrot: ANN. OF SURG., April, 1912, lv, p. 623.

³ Darrach: ANN. OF SURG., November, 1912, lvi, p. 802.

by Stimson,⁴ Holst,⁵ and Leuven,⁶ making 33 in all. Those associated with fracture of the radius are far more common, but are very apt to be overlooked. The dislocation is usually reduced with the fracture, and generally heals with it. Occasionally, however, the ulnar head remains out of place, and this is often recognized only after the swelling has gone down and the splints removed, as in the case shown at a meeting of the New York Surgical Society last May.⁷ In another group, the main lesion is not the lack of reduction, but the tendency toward imperfect repair of the structures on which the strength of the joint depends; namely, the triangular ligament and the joint capsule. The former, with its attachments to the sigmoid cavity of the radius and the base of the ulnar styloid, is the most important, and when this is torn across, or when the styloid is torn away from the ulna close to its base, the ulnar head loses its stability and a lax joint results. This laxity may be only an abnormal mobility of the ulnar head which interferes but slightly, if at all, with the function of the wrist, or it may be sufficient, as in this case, to allow the head to slip out of the sigmoid cavity. Habitual dislocation at this joint seems to have received scant attention, and with the exception of three cases reported by Hoffa,⁸ and three by Courtin,⁹ the speaker said he had found nothing beyond mere reference to its possibility. The impairment of function in this case was not sufficient to warrant immediate operative measures, and the use of a leather wristlet had been advised for a period of some months. If he then found sufficient disability, a resection of the lower inch of the ulna would seem the best procedure. In order to actually repair the damage it would be necessary not only to obtain union between the ulnar head and styloid and reef the capsule, but also to overcome the backward bending of the radius, with its resulting strain on the front part of this joint.

⁴Stimson: N. Y. Med. Jour., May 25, 1889.

⁵Holst: Centr. f. Chir., 1891, No. 25, p. 496.

⁶Leuven: Centr. f. Chir., 1906, No. 42, p. 1128.

⁷Darrach: ANN. OF SURG., November, 1912, lvi, p. 801.

⁸Hoffa: Verhandl. der Deutsch. Gesellsch. f. Chir., 1898, Pt. 1, p. 156.

⁹Courtin: Gaz. hebdomadaire des Sc. Med. de Bordeaux, October 8, 1905, p. 481.

TUBERCULOUS PERITONITIS SIMULATING RECURRENT
ATTACKS OF APPENDICITIS.

DR. W. S. SCHLEY presented a young man of nineteen who was admitted to the hospital on December 27, 1911. His chief complaint was pain in the right lower quadrant of the abdomen. His family history was good, both parents being alive and well. Two years ago he had suffered from cough and expectoration, and was told that he had trouble with the left apex. He gave up his work, lived out of doors, and had apparently recovered. About eight months ago he began to suffer with stomach disturbances, eructations of gas and gurgling, but he did not lose weight. Three months before coming to the hospital, and while at work, he was seized with a severe epigastric pain; he managed to complete his day's work, however, and by night the pain had passed off. There was no nausea with this attack. Six weeks later he had a similar seizure, the pain lasting about eight hours and extending from the epigastrium to the right lower quadrant. He felt uneasy and tired before the onset of the pain. Two weeks before admission he had a third similar attack, the pain being most severe in the right lower quadrant. It persisted about twelve hours, and was accompanied by nausea and vomiting. Constipation had preceded this attack.

The patient was seen by a physician at this time, and the case was regarded as one of appendicitis. Since his first attack there had been some soreness in the right lower quadrant, with occasional twinges of pain. His general appearance, on admission, was that of a well-nourished, muscular, healthy young man. In the chest, an occasional fine râle could be heard at the right apex posteriorly. Expansion was good and equal on the two sides. The heart sounds were clear and strong; the rate 56 per minute. In the abdomen there was a small area of tenderness to the right and below the umbilicus, without rigidity. There were no masses to be felt. The superficial glands of the body were not enlarged. The temperature, on admission, was $97^{\frac{3}{5}}$ and beyond a slight rise to $100^{\frac{4}{5}}$ following the operation, the temperature remained practically normal.

At operation, through the usual intermuscular appendix incision, there were found scattered over the peritoneal surfaces numerous discrete, pearly nodules, varying in size from a pin-point to a pin-head. These were very numerous in the mesentery

of the appendix, and became more scattered as one left that region. The loops of the ileum were drawn down into the wound, and showed a few tubercles, and there were more upon the visceral than upon the parietal peritoneum. The serous surfaces were moist, but there was no fluid. There were no adhesions. The appendix itself lay below the caput, towards the pelvic brim; it was but moderately congested, and showed only a moderate number of tubercles on its surface. The presence of so many tubercles in the mesentery was thought to indicate a possible lesion of the mucosa, peritoneal invasion being most marked near the seat of origin.

The appendix, on removal, showed but moderate thickening of its coats. The internal calibre was even throughout, and there were no constrictions. It was empty. There were several small hemorrhagic spots in the mucosa, but no ulcerations. Microscopic examination showed that the tubercles were confined to the peritoneal coat.

The interesting features of this case, Dr. Schley said, were the previous pulmonary lesion, the apparent excellent health of the boy, notwithstanding the fairly extensive peritoneal involvement, the close simulation of his attacks to recurrent appendicitis, and his apparent entire restoration to health after the removal of the appendix and the involved mesentery and a year's sojourn in the country, where he would continue to reside indefinitely.

TUBERCULOUS PERITONITIS FROM INFECTED ADNEXA.

DR. W. S. SCHLEY showed two patients; the first case was that of a mulattress, twenty-three years of age, a laundress by occupation, who entered the hospital on December 23, 1912. Her chief complaint was pain low down in the right abdomen, which became so acute six days before her admission that she had to give up her work. Three years ago she had had a similar attack, which disabled her for a few days, but during the interval, with the exception of constipation, she had enjoyed fairly good health. She had begun to menstruate at the age of sixteen and had always been regular. There was no history of previous pelvic trouble; no pregnancies. The patient was a well-nourished woman, and did not appear to be acutely ill. An examination of the chest was negative. The abdomen was soft, and no masses could be felt. There was slight tenderness low down on the right

side. Vaginal examination located the uterus in the hollow of the sacrum, and there was a mass in the right side; this was connected with the uterus and both were fairly well fixed. The case was regarded as one of chronic salpingitis.

Operation showed that throughout the abdomen and as far as the exploration could be carried there were dry adhesions of the intestines to the abdominal wall and to each other, a peritoneal obliteration. There were a number of vascular bands of small size, and scattered here and there on the surface of the intestines were small, seed-like yellowish nodules. It was only with the greatest difficulty that he was able to reach down to the right tube, which was much thickened and adherent, and showed larger tubercles on its surface. The tube was excised, and the abdomen was closed, as the left tube, while adherent, was not apparently invaded.

This patient had done extremely well, and had gained in weight since leaving the hospital. She still complained of some pain in the right side, but it was much less severe than formerly. She was still constipated. Her condition of nutrition and general health, in spite of the profound peritoneal matting, seemed remarkable.

The second case was that of an Italian woman, a housewife, twenty-five years old, whose chief complaint was pain in the right lower quadrant of the abdomen. This began three months ago; it had been gradually getting worse, and was most severe on exertion and during the menstrual epochs. The latter function, however, had been normal as to time and flow. The patient had been married for eight years; she had miscarried during the second year of her marriage and had not been pregnant since.

Her appearance on admission to the hospital was and still remained up to the present time that of a well-nourished woman, with a good color of the skin and mucous membranes. She did not look ill. Nothing abnormal was found in the chest. The abdomen was soft, without masses, with moderate tenderness over the lower part on both sides. The uterus was retroverted and fairly firmly fixed in the hollow of the sacrum. There was tenderness in both lateral fornices, with some induration. A diagnosis of chronic salpingitis was made.

Examination under ether showed a hard, small uterus, retro-

verted and fixed, with induration and a sense of a mass high up on either side. On opening the abdomen, the intestines were found to be matted together and to the abdominal wall, the condition being similar to that described in the previous case, excepting that in this case the adhesions were more dense and there were more numerous vascularized bands. It was practically impossible to reach the uterus or the right tube, which was felt to be hard and enlarged by an examination with one hand in the vagina and the other in the abdomen. The adhesions were so dense that attempted separation involved the peritoneal coat to a dangerous extent, with the imminent danger of causing a perforation. The tubes apparently lay matted to the intestinal coils and not in the cul-de-sac. Macroscopically, there were no tubercles.

The interesting features of these cases were the apparent good health of the patients, and, in the cases of the two women, the absence of more severe pelvic and intestinal symptoms. The constipation was only moderate; the nutrition was good and had improved during the past few months, notwithstanding a matting of the gut so great and extensive as to render it apparently almost immobile. This feature of the nutrition had been noted by others in similar cases. The condition in the women was undoubtedly in the so-called terminal or curative stage, there being every evidence that they had, at least temporarily, overcome their infection. Whether called a chronic fibroid tuberculosis or a fibro-adhesive tubercular peritonitis, the tubercles were largely replaced by connective tissue. The cases were probably never of the ascitic variety. In both of these cases the disease process had been of some duration, but they had only applied for relief when the contractions and distortions of the newly-formed tissue caused pain, and not because of any toxæmia or interference with health from the tuberculosis, notwithstanding the fact that the focal infection in the tubes had not been removed. In these cases it was impossible to palpate or examine the liver or spleen or peritoneal glands with any degree of accuracy. About 68 per cent. of these cases, Dr. Schley said, were of the exudative type, 27 per cent. of the fibro-adhesive type and but 4 per cent. of the suppurative. Post-mortem figures gave a slightly greater preponderance to the occurrence of this condition in males, and the operative figures to the female. This discrepancy might be explained from a symptomatic standpoint, as even the milder

forms in women were usually accompanied by disturbance in the pelvic organs, which caused them to seek relief. About 50 per cent. of the ascitic cases were said to go two years without a recurrence of the trouble, while only 30 per cent. or 40 per cent. reached the three year limit. Symptomatic and practical recovery from even the most advanced condition of tuberculous peritonitis was far from unknown.

DR. HENRY H. M. LYLE said that cases of tuberculous peritonitis belong to a class of tuberculous cases in which heliotherapy did the most good. After operation it was essential to treat these patients by exposure to the sun in order to assure a permanent cure of the tuberculosis, and in all later cases that he had operated on, he had used this method.

DR. WILLIAM C. LUSK said that in a case of extensive tubercular peritonitis, with tubercular involvement of the endometrium, tubes and ovaries, after removal of the adnexa, with fresh air treatment, great gain in health ensued, but the uterine hemorrhages and a tubercular infection of the abdominal wound persisted. These latter conditions became cured following the administration of tuberculin, in conjunction with the use of which the opsonic index, which had previously been low, rose to a high degree. The patient is now living and without recurrence, seven years post-operative.

PRIMARY SPLENOMEGALY OF THE GAUCHER TYPE: SPLENECTOMY.

DR. WILLIAM A. DOWNES presented a woman, twenty-eight years old, who was born in eastern Tennessee and who had spent most of her life in the South.

The patient stated that she had never been strong, like other children, and was always easily fatigued. When she was thirteen years old she was so weak that she consulted several physicians, and at that time a mass was observed in the left hypochondrium. The physicians she saw were not positive whether this was the spleen or kidney. She was quite pale and was given iron and arsenic, and external applications were applied over the tumor. She improved temporarily, and then again began to suffer from general weakness. The mass in her abdomen gradually increased in size. She consulted other physicians, who told her that the mass was her spleen. For years she had suffered from a dull

headache; the pain was usually in the occipital region and extended to the back of the neck. It was always worse at night. For the past ten years she had been troubled with insomnia, and suffered much from a dull, aching pain in the small of the back; this had been almost constant, but had varied in severity. She felt as if her back was "in a strained position," and had a sensation of weight or heaviness in the abdomen. At times there were shooting pains throughout the abdomen; at other times she had pain in the left hypochondrium. She had long suffered from shortness of breath on slight exertion; her limbs felt tired and had ached as though her "bones were sore."

Upon inspection, the patient showed evidence of rather severe anæmia. There was pigmentation of the forehead, sides of the nose and cheeks and the chin. The conjunctivæ presented, in a measure, the wedge-shaped thickening referred to by Brill. Examination of the abdomen showed that practically the entire left side was occupied by a smooth, fairly movable tumor which was without doubt the spleen, extending to within three inches of the umbilicus and well down into the pelvis. The liver was palpable below the margin of the ribs, but was not much enlarged. There was no free fluid in the abdomen. The superficial lymph nodes were not palpable. No pain nor tenderness was elicited by pressure over the long bones. Except for a moderate retroversion, an examination of the pelvic contents was negative.

The patient's weight, when she came under Dr. Downes's observation, was 113 pounds. An examination of the blood for the malarial organisms was negative, as were also the Widal and Wassermann tests. On October 4, 1912, a blood examination showed 3,840,000 red cells; 1400 white cells; 60 per cent. of polymorphonuclears; 40 per cent. of mononuclears and 49 per cent. of hæmoglobin. The urine contained a trace of albumin. A radiograph of the abdomen was negative. The patient was put on iron and arsenic, and during the next three weeks she gained four pounds in weight and the hæmoglobin increased to 57 per cent. However, the leucopenia became more marked, the count showing as low as 900 white cells per cm. on October 28. Under forced feeding and increasing doses of iron and arsenic, the blood picture showed some improvement, the hæmoglobin increasing to 65 per cent., while the count had not changed materially.

Operation, December 14, 1912: The spleen was removed through an eight-inch incision through the middle of the rectus. It was free from adhesions, excepting posteriorly, and these were easily broken by the hand after the pedicle had been secured. There were four or five anomalous vessels of large size, which were secured separately. A small cigarette drain was introduced at the centre of the wound, as there was some oozing from a small tear in the mesentery.

The operation produced very slight shock and the patient made an uneventful recovery excepting that on the day after the operation she had a hemorrhage in the right conjunctiva, and an ecchymotic area about the size of an adult palm over the right buttock. She was given 20 c.c. of horse serum hypodermatically, and there were no further evidences of a tendency to bleed. The drain was removed on the seventh day. The temperature ranged between 100 and 101 for twenty-one days, then gradually falling to normal. The wound healed without any trouble. Four days after the operation a blood count showed 3,860,000 red cells; 16,000 leucocytes; 97 per cent. polynuclears and 76 per cent. of hæmoglobin. When the patient left the hospital, on January 24, 1913, 41 days after the operation, the blood count was 4,800,000 red cells; 8800 white cells; 45 per cent. of polynuclears; 16 per cent. of large lymphocytes; 26 per cent. of small lymphocytes; 8 per cent. of transitional cells and 3 per cent. of eosinophiles. At this time the patient weighed 116 pounds, and her general condition was rapidly improving. The shortness of breath had disappeared, and barring some pain in the back shortly after the operation, she had suffered no discomfort, nor had she had pain in the long bones.

The pathological report in this case, made by Dr. Tytler, was as follows: The weight of the spleen, together with the extravasated blood, was 1813 grams, and it measured 35 x 135 x 6.5 cm. It was oblong in shape and fairly uniform in thickness. The surface of the organ showed a uniformly smooth and transparent capsule, save for scattered, very fine dew-like points of less than 1 mm. diameter. Its color was uniformly reddish-brown, with a grayish tinge. The organ felt rather firmer and more leathery than normal,—of about the consistence of soft liver. On section, it cut readily. Its cut surface was flat, firm and leathery; considerably less friable than normal spleen. Its color

was reddish-gray, which on closer examination was seen to be due to innumerable pin-point gray points, separated by a small amount of dark red substance. Here and there were seen scattered circular, dark red spots, of about 1 mm. diameter, which were distinctly raised above the surface. The trabeculae were almost indistinguishable, and there was no evident increase of connective tissue about the main vessels. Microscopic sections showed the condition which had been previously described as a primary epithelioma, and more recently by Bovaird, as a primary endothelioma.

DR. JOHN F. ERDMANN showed a spleen which he removed about a year ago from a child then three years and three months old. The case was one of primary splenomegaly of the Gaucher type. The child at this time was in very poor condition; it weighed 27 pounds and gave a recent history of double middle ear trouble and bronchitis. Dr. Erdmann said that in this case he was able to remove the spleen without much difficulty, excepting that he had found it necessary to include about an inch of the pancreas. The weight of the spleen was about one-twentieth of the weight of the child. The child was discharged from the hospital on the eighteenth day, and since the operation, which was done about a year ago, it had remained in good health, had gained weight and shown improvement generally, including the condition of the blood.

Dr. Erdmann said he thought this type of splenomegaly was a family disease, as there were a number of cases on record where it affected several children in the same family. In the case he had reported, it was the second case in that particular family.

DR. F. S. MANDLEBAUM (by invitation) said that of the five operated cases thus far on record, there were two deaths, which was a mortality of 40 per cent. The case shown by Dr. Downes and the one now reported by Dr. Erdmann would lower this rate materially. The speaker said that about two months ago, when he last reviewed the literature of the subject, he had found only ten authentic cases on record, to which he had added the eleventh. A number of cases of so-called Gaucher splenomegaly had recently been described, but apparently they did not prove to be of that type. The disease was a very rare one, and as Dr. Erdmann just mentioned, it often affected several members of the same family. As a rule, the females were affected rather than the males; only

two cases in males had been recorded, one by Brill, Libman and himself in 1904, and the other, his own recent case.

Up to about ten years ago, Dr. Mandlebaum said, the Gaucher type of splenomegaly was not recognized clinically, and the various types of enlarged spleen had been grouped together in the class of splenic anæmias. Shortly after the report of Bovaird's case, Brill published a paper in the *American Journal of the Medical Sciences*, stating that the three cases he had under his observation for many years must be of the Gaucher type, basing his opinion on the findings of Bovaird, whose case was not, however, recognized as belonging to this type until it came to autopsy.

In this disease the enlargement of the spleen usually begins in early infancy, followed later by enlargement of the liver. There are no palpable lymph nodes, and the blood picture shows nothing characteristic. The prominent symptoms are often caused solely by pressure from the enlarged spleen. The patients have a unique brownish pigmentation of the skin, especially on those parts exposed to the light, and there are peculiar changes in the conjunctivæ. Dr. Mandlebaum said he had had the opportunity of making an autopsy on two of Brill's cases, and both proved to be of the Gaucher type. The speaker said that in his own case, the diagnosis had been made by Dr. Mark S. Reuben, of this city. In the case reported by De Jong and Van Heukelom, the diagnosis was also established clinically.

The course of the disease is very chronic, the patients usually dying from some intercurrent affection. A splenectomy could not be expected to cure these cases, as in Banti's disease, because the bone marrow and the lymph nodes were involved as well. The speaker suggested that these cases be kept under observation, so that an autopsy might eventually be obtained with the object of learning what changes might occur in the bone marrow and lymph nodes after splenectomy.

In reply to a question, Dr. Mandlebaum said the weight of the spleen varied greatly. In his own recent case, a child, it weighed 490 grams, while in the second case reported by Brill, Libman and himself, it weighed 7400 grams (over 14 lbs.), being the largest recorded in this disease.

DR. WALTON MARTIN showed a spleen which he removed about a month ago. The case was regarded as one of splenomegaly, and the operation was done under that assumption, but

upon opening the abdomen it was found that the man had a syphilitic liver and that the splenic enlargement was also secondary to syphilis. The man made a good recovery. The spleen in this case weighed about 1700 grams, and gave the patient a great deal of discomfort because of its size.

UNUNITED FRACTURE OF THE HUMERUS.

DR. DOWNES presented a woman, fifty-seven years old, who was admitted to the New York Hospital on September 27, 1912, with the history of having fractured her left humerus six months before, non-union resulting. The X-ray showed an extremely oblique fracture, involving six inches of the shaft of the bone and extending to within one inch of the head.

An open operation was done on October 3, 1912. Dr. Downes said it was his intention to introduce a bone graft, but upon exposure it was seen that the extreme obliquity of the fracture had practically destroyed the lumen of the bone, and it was out of the question to attempt to introduce an intramedullary support of any kind. About two inches of the end of the proximal fragment was thereupon removed and the fractured surfaces of each fragment freshened with the curette. An aluminum bronze wire suture was then passed through a drill-hole and around the shaft just at the point where the tip of the upper fragment joined the lower; similarly, a heavy kangaroo tendon was passed above at the junction of the tip of the lower fragment with the upper. The wound was then closed without drainage, and a plaster case was applied.

The woman being very stout, the case became irksome, and at the end of one week she complained that she could not stand it any longer. It was therefore removed, and with a small pad of absorbent cotton between the arm and chest, the upper arm was bandaged directly to the body and secured in this position by wide strips of adhesive plaster encircling the chest. This dressing was left undisturbed for six weeks, when it was renewed, the arm being kept immobilized for about three months. At this time union had taken place and was fairly firm, as shown by examination and X-ray.

This case was shown, Dr. Downes said, principally to illustrate an unusual condition of oblique fracture of the humerus, and also to emphasize the fact that complete immobilization could be easily obtained by the use of the body as a splint, a

method which would seem to be useful in cases where a case was inadvisable or impracticable.

LYMPHANGIOPLASTY.

DR. ALFRED S. TAYLOR presented a woman who about nine months ago was bitten on the hand by a dog. The wound was cauterized. Several weeks later there was tremendous swelling of the hand on the affected side, followed by swelling of almost the entire extremity. She visited various dispensaries, where several incisions were made, and finally she came to the Fordham Hospital, where it was determined to try the Handley method of lymphangioplasty. The operation was done nine days ago, when, under ether, three different channels were made under the skin from the shoulder to the elbow through each of which four strands of heavy, twisted silk were passed. With the exception of a temporary return of the swelling on the third day, due to an error made by one of the nurses in putting on a tight dressing, marked improvement followed the operation, and the arm was now about normal size. There was still some swelling of the fingers, which could be relieved by massage.

LYMPHANGIOPLASTY: HANDLEY'S METHOD.

DR. PARKER SYMS read a paper with the above title, for which see page 785.

DR. TAYLOR said that in addition to the case shown to-night, he had employed the Handley method in one other case, that of a woman, with marked œdema of the lower eyelid, the result of a scar. In that case, two or three strands of floss silk were inserted, and after five or six weeks there was very marked improvement, and the patient now had a perfectly normal lower eyelid.

DR. ERDMANN said he had tried the Handley method in one case of œdema of the leg. The patient was a man, about twenty-five years old, with profound œdema of the right thigh and a portion of the scrotum. He was admitted to the Post-Graduate Hospital, where the case was first regarded as one of filariasis, but nothing was found in the blood or urine, in spite of very careful observation. Dr. Erdmann then inserted three long heavy silk strands, extending from the ankle up to the abdomen. The immediate result of the operation was astonishing, the œdema decreasing at least 20 per cent. This improvement was main-

tained as long as the man remained in the hospital, and kept his leg in a fairly elevated position. The operation was done about a year ago, and Dr. Erdmann said he had since heard from the man's physician that the improvement in the œdema had disappeared after the man left the hospital and had neglected himself.

DR. LYLE said that in cases of filariasis attempts had been made to reduce the œdema by setting up a collateral circulation between the lymphatics and the bone cavity by implanting into it the fascia lata, in the hope that the bone circulation would carry off the excessive lymph. Dr. Lyle thought that this was a much more rational procedure than the string method.

DR. ARTHUR L. FISK said he thought a certain amount of caution should be exercised before resorting to this method, as in many of these cases a collateral circulation was eventually re-established. We knew that in milk-leg and phlebitis there was manifest œdema which might persist for some time, but which eventually disappeared.

DR. SYMS, in closing, said the immediate result of the Handley operation was usually very promising, the swelling often disappearing rapidly, but the end results were apt to be disappointing.

Cases have been reported where the cure has been apparently permanent, but we should not lose sight of the fact to which Dr. Fisk called attention that some of these cases were such as might improve or get well without operative interference.

The speaker said that the method seemed to be promising in cases of ascites. However the method should be given further trial, for more evidence is needed before we can form conclusions.

RÖNTGEN RAY PLATES DEMONSTRATING RE-ESTABLISHMENT OF COMMUNICATION BETWEEN THE STOMACH AND THE DUODENUM AFTER PYLORECTOMY.

DR. A. V. MOSCHCOWITZ said that at the preceding meeting of the Society, Dr. George E. Brewer had presented a series of cases of duodenal ulcer which gave rise to considerable discussion as to the necessity of occluding the pylorus when making a gastrojejunostomy for the cure of the ulcer. In discussing this point, Dr. Moschcowitz said he had pointed out that it was not an easy matter to occlude the pylorus, and a case which they had under observation at that time at the Mt. Sinai Hospital had prompted him to make the statement that even pylorectomy was not absolutely certain to produce pyloric occlusion. This

statement seemed to have been received with considerable incredulity, and on account of the importance of the subject the speaker said he had deemed it his duty to present this evening the Röntgen plates of the case in question. The history of the case was as follows:

The patient was a man of thirty-four, an ice-carrier by occupation, who was admitted to the hospital on April 3, 1912. He stated that six years ago he had suffered from pain in the epigastrium; this he described as burning in character and increased by the ingestion of food. It did not radiate. He also suffered from nausea and frequently vomited a brownish material. There was no distinct hæmatemesis. These symptoms lasted about six months, and since that time he had enjoyed only fair average health and had had an attack of vomiting every week or two. For four weeks prior to his admission he had suffered from constant epigastric pain and had vomited daily, usually at night. Physical examination was negative, excepting for tenderness in the epigastrium. A test meal showed well marked hyperacidity. There was much retention of foul contents in the stomach, and on one occasion raisins were recovered after twelve hours.

On April 11, 1912, Dr. Arpad G. Gerster performed pylorotomy and gastrojejunostomy with the Murphy button. There was considerable post-operative vomiting, requiring frequent gastric lavage for one week. The symptoms closely resembled those associated with acute dilatation of the stomach, as much as three quarts of contents being frequently syphoned out. The pathologist reported a chronic ulcer of the pylorus; no evidence of malignancy. The patient was discharged, well, on May 7, 1912.

On January 14, 1913, he was readmitted, complaining of a recurrence of his old symptoms. Four days later he was fluoroscoped by Dr. Jaches, who reported that bismuth-zoolak found its way through the cardia gradually and with considerable difficulty, and it could be observed that the weight of the bismuth rather than peristalsis brought it down to the prepyloric region. After the lapse of about ten minutes, the food began to pass slowly through the stoma. An hour later the food was still seen to pass through the stoma, but part of it also passed through the pylorus. Notwithstanding this double passage, however, a moderate residue still remained in the stomach after six hours.

Based on the above report by Dr. Jaches, the speaker said he had made the statement at the last meeting that even pylorotomy was not absolutely certain to produce pyloric occlusion. In order to verify this, he had again sent for the patient and had again had him flouroscooped, and also had plates made. Dr. Jaches reported as follows: On January 27, 1913, this patient was submitted to another X-ray examination, because at the examination made ten days previously the main reliance was placed on the flouroscope, and the few plates which were taken did not show the passage of the bismuth-zoolak through the pylorus. At the second flouroscopic examination, the passage was again noticed; it did not show up as clearly as the first time, but a number of plates were taken and most of these showed the passage of the bismuth. Plate 1, which was taken about half an hour after the ingestion of the bismuth, showed the food passing through the stoma, and a considerable quantity already in the coils of the small intestine, and it also showed some bismuth in the duodenum (probably the second portion), also passing downwards. Plate 2 and plate 3, taken a few minutes later, showed practically the same conditions. Plate 4, taken one hour before, again showed the bismuth in part of the duodenum. Plate 5, taken an hour and three-quarters after the ingestion of the meal, again showed bismuth passing through the pylorus.

Dr. Moschowitz said he had not had the time to look up the literature on the subject, but he had a distinct recollection of having read of similar occurrences in experiments on animals. At the last meeting, Dr. Charles A. Elsberg had related similar personal experiences with animals.

*Stated Meeting, held at the New York Academy of Medicine,
February 26, 1913.*

The President, DR. CHARLES L. GIBSON, in the Chair.

PERFORATING DUODENAL ULCER.

DR. NATHAN W. GREEN presented a man, thirty-seven years old, who gave a history of intermittent gastric trouble dating back for three or four months. When he was admitted to St. Luke's Hospital, on November 11, 1912, he complained of pain

in the lower right side which had come on suddenly about eight hours before. Examination showed a point of tenderness an inch above and to the right of the umbilicus.

Through a right rectus incision a perforating ulcer of the first part of the duodenum was found, together with peritonitis of the right gut. The lesion was inverted, and this interfered with the lumen of the gut to such an extent that a gastro-enterostomy was done immediately. The patient made an uninterrupted recovery. This case gave the typical history of hunger pains coming on 3 or 4 hours after eating and being relieved by food.

Dr. Green presented a second case of perforating duodenal ulcer in the person of a man who gave the history of having had pain, fairly well localized above the umbilicus, for about two months before his admission to St. Luke's Hospital, on January 27, 1913. Five hours before he was admitted he had a sudden sharp pain in the lower abdomen, and he was brought to the hospital late at night with the diagnosis of appendicitis. The appendix was explored and found to be normal. The presence of a thin, brownish fluid was noticed in the right hypogastric region, and upon exploration with the hand in the abdomen, a perforating, punched-out ulcer was found. Through a right rectus incision this proved to be located in the duodenum. It was inverted as in the previous case, and a gastro-enterostomy was at once performed and the wound closed. The abdominal wound reopened on the ninth day due to lack of general nutrition, when it required resuturing. The patient's further recovery was uneventful.

This case presented no hunger pains, but gave a history of pain one hour after eating and relieved by vomiting. This and the punched-out appearance would make one think of gastric ulcer, but as the location was to the right of the hepatic artery and portal vein (boundary of foramen of Winslow) it was considered a duodenal ulcer. The finer landmarks were obscured by old adhesions.

DR. WILLIAM A. DOWNES thought Dr. Green had acted wisely in doing an immediate gastro-enterostomy after closing the duodenal perforation. The speaker said he could recall two cases where a secondary gastro-enterostomy became necessary, one two years, the other three or four years after the primary opera-

tion. He saw no reason why a gastro-enterostomy should not be done at once, if the condition of the patient warranted the prolonged operation, and these cases are usually in good condition if they come under observation within a few hours after the perforation occurs.

DR. CHARLES L. GIBSON said that personally he had never done a gastro-enterostomy in a case of perforating gastric or duodenal ulcer, and he had never had occasion to regret it. He thought it should only be done in exceptional cases, where there was evident obstruction. In one case which he operated on recently he found two acute perforating ulcers of the duodenum, which he closed by infolding them with a purse-string suture; although this procedure caused a slight stenosis of the pylorus he did not do a gastro-enterostomy. In that case, although the patient made a good recovery, a subsequent gastro-enterostomy might become necessary, but personally he was rather inclined to resist the present-day tendency to do a gastro-enterostomy in these cases as a routine procedure.

SEPTIC SECONDARY HEMORRHAGES SUBSEQUENT TO AMPUTATION OF THE BREAST FOR CARCINOMA.

DR. ALEXIS V. MOSHCOWITZ presented a woman, thirty-eight years old, who was admitted to Mt. Sinai Hospital, in the service of Dr. Gerster, on November 11, 1912, suffering from a tumor of the left breast. She had first noticed this growth about two months before, and during that period it had increased very rapidly in size. The salient points of the physical examination of the patient were that practically the entire left breast was involved; that the tumor was very hard, and that there were massive glands in the corresponding axilla. A notable feature of the case was that though the integument covering the breast was very much thinned, the result of stretching, it was not adherent and evidently not involved.

On November 13 a typical amputation of the breast and axillary contents was done, together with extirpation of both pectoral muscles. The operation was exceedingly easy, and including the suturing and dressing, consumed less than fifty minutes. In connection with the operation it was of importance to note that in spite of the very extensive removal of the skin,

the remainder was readily approximated without the slightest tension.

The first dressing was on November 16, merely with the object of removing the axillary drainage tube. At this time there was already noticed a very suspicious cyanosis of the skin flaps, as of an impending necrosis. After this the patient complained of considerable pain and discomfort in the region of the wound. She had an evening rise of temperature to 102.5, but there was never more of a purulent discharge than could be accounted for by the rather extensive sloughing of the skin flaps, which had actually occurred. At no time was there any actual sloughing of the deeper tissues. The upper part of the incision healed by primary union.

On November 24, the eleventh post-operative day, the dressings were found to be saturated with blood, and examination showed that the wound was covered with a soft blood clot, about five inches in diameter and half an inch thick. When this was gently lifted off, there were exposed two bleeding areas, each about half an inch in diameter, one situated just below the clavicle; the other near the inferior angle of the incision. A purse-string suture encircling these points controlled the bleeding completely for the time being. The general condition of the patient was poor. The pulse was rapid and weak, but regular, and there were no signs of marked loss of blood.

On the following day a similar hemorrhage occurred from a point situated about the centre of the granulating area. The next day there was no bleeding, but as a prophylactic measure, 15 c.c. of human serum were injected subcutaneously. On November 27, the fourteenth post-operative day, there was again very active bleeding, approximately from the same areas which had been sutured three days before. This time the bleeding was checked by firm tamponade with gauze, dipped into a mixture of adrenalin and diphtheria antitoxin. The patient's hæmoglobin content dropped to 40 per cent., and the coagulation time was found to be ten minutes. The general condition of the patient was now very poor: she refused all nourishment, was very weak, and the outlook seemed well-nigh hopeless. There were, however, no further hemorrhages until December 1, the eighteenth post-operative day. Again there was a cessation of all bleeding until December 4, when on exposing the wound there was found

an actively spurting vessel in the fourth intercostal space (perforating artery), about half an inch external to the border of the sternum. This was caught with forceps and ligated.

On the following day the patient was removed to the out-door ward, which was situated on the roof, and almost miraculously her condition began to improve, her temperature dropped to normal, and no further hemorrhage occurred. By the middle of January her wound was in a condition to permit of skin grafting, and the patient was discharged, practically well, on February 18, 1913.

TOTAL LARYNGECTOMY FOR EPITHELIOMA OF THE LARYNX.

DR. WILLIAM DOWNES presented a man, sixty years old, upon whom he had operated January 27, 1913, on account of epithelioma of the larynx, the symptoms of which dated back about two months. The larynx was freely movable and there was no general lymphatic involvement, but on the right side of the interior of the larynx, the place normally occupied by the ventricular band (or false vocal cord) was taken by a red, cylindrical swelling with a slight constriction near the arytenoid. Outside the arytenoid and the aryteno-epiglottic fold was an ulcerated area that bled easily. The vocal cord was not visible, as the swelling in the region of the false vocal cord extended so far inward as to shut off a view of the cord.

Total laryngectomy was performed by Dr. Downes on January 27, 1913. An incision was made from the hyoid to within a short distance of the suprasternal notch, with liberating cuts on either side just below the hyoid. The larynx was freed anteriorly, and the trachea exposed and divided at the first ring. The trachea was then brought forward through a transverse skin incision just above the sternal notch, this incision being separated from the lower end of the original incision by a bridge of tissue one inch wide. The ether, which had been given with open mask up to this time, was now administered through an intratracheal cannula with the Janeway insufflation apparatus, and the anæsthesia was at all times smooth.

The larynx was dissected from the œsophagus from below upward, and when it was found that the growth involved the

pyriform fossa and the false cord of the right side, a very large opening was necessarily made in the pharynx in order to get wide of the disease. The epiglottis was included with the larynx. The large opening in the pharynx was closed with fine chromic gut with much difficulty. Wide gauze packing saturated with a one per cent. iodine solution was placed well down in the lower angles of the wound on either side of the trachea with the object of setting up inflammatory adhesions and thereby preventing infection from spreading in this direction. A small drain was inserted into the upper end of the wound, and the skin partially closed. A No. 24 French catheter was introduced through the left nostril well into the œsophagus for feeding purposes. By the use of the suction apparatus with a small mouth tip, the pharynx was kept free from saliva almost from the start, the patient soon learning to use this means of clearing his throat. Dr. Downes said he felt confident that the use of this apparatus aided greatly in obtaining primary union in the large pharyngeal wound. The gauze pack was removed from the lower part of the wound on the fourth day, and the walling off was apparently complete, as there was no tendency for secretions to burrow into the mediastinum. The feeding tube was kept in the nose for two weeks: after this all feeding was by the mouth, the food for a few days consisting of liquids only, soon followed by semi-solids. At no time was there any leakage from the pharyngeal wound.

The patient's temperature was 101° the day after the operation, and never above 100° after the fifth day. The speaker said he attributed this uneventful convalescence to the fact that infection did not spread to the mediastinum, showing the value of the gauze pack. He also believed that he was assisted in obtaining complete primary union in so large a pharyngeal wound by the use of the sucker, which kept the pharynx free from saliva and mucus. At the present time the wound had healed, with the exception of a very small granulating area at the upper angle.

Examination of the specimen after removal showed an ulcerated surface of about one square inch in the pyriform fossa. The hard nodular growth had extended to the arytenoid and the false cord, but did not involve the true cord. The growth evidently began in the pyriform fossa or sinus, and was therefore extrinsic. Pathologically, it proved to be an epithelioma.

TOTAL LARYNGECTOMY FOR CANCER OF THE LARYNX.

DR. FREDERICK KAMMERER presented a man now about fifty-five years old, upon whom Dr. Kammerer did a total laryngectomy for intrinsic cancer of the larynx over four years ago. The patient was first presented to the Society on March 10, 1909, six months after the operation, and he had shown no evidence of a recurrence up to the present time.

At the operation, a tumor, as large as a walnut, involving mainly the left vocal cord, was found. There was no involvement of the lymphatics in the neck. A preliminary tracheotomy had to be done four weeks before the laryngectomy on account of respiratory obstruction.

Dr. Kammerer also briefly mentioned two other cases of laryngectomy for extrinsic cancer upon which he had operated during the past two years. In one of these cases he removed the larynx, over five inches of the pharynx and œsophagus, and the left half of the thyroid gland. This patient had a fatal recurrence one year later. In the second case, operated on almost a year ago, where a considerable portion of the pharynx was removed and a plastic operation had been successfully done to re-establish the continuity of the digestive tract, a recurrence immediately above the tracheal opening was now present. Such cases of early recurrence after very extensive laryngectomies were rather discouraging, and, in conjunction with the case presented to-night, emphasized the well known fact of the more benign nature of those cases in which the growth originated in the interior of the larynx.

DR. GIBSON said that Dr. Downes's method of preventing the spread of infection by gauze packing saturated in a one per cent. iodine solution and placed well down in the lower angles of the wound on either side of the trachea had impressed him very favorably, even more so than that suggested by Dr. Crile, who advised a preliminary operation with this same object in view.

SARCOMA OF THE LEFT SUPERIOR MAXILLA:
EXTIRPATION.

DR. HOWARD LILIENTHAL presented a woman, twenty years old, who was admitted to the Mt. Sinai Hospital on December 5, 1912. She had been married about fifteen months, and had a

young baby. Nine months ago she first noticed a growth in the left cheek, which had been slowly increasing in size. This had never been painful.

On examination, there was a large, hard swelling over the left superior maxilla and involving the bone itself. There was bulging of the outer wall of the left nostril, and through the mouth the superior maxillary bone was found to be enlarged in the region of the first and second molars; this enlargement extended into the nose and was plainly seen by the X-ray as a dense shadow of apparently thickened bone, extending to the orbit. An examination of the blood gave 12,000 leucocytes, with 68 per cent. of polymorphonuclears. The urine was negative. The temperature ranged between 99 and 100; pulse, 84; respirations, 20.

On December 9, 1912, under ether intratracheal anæsthesia, the left common carotid was exposed by an incision in the neck, parallel with and in front of the left sternomastoid muscle. Dr. Lilienthal said it was his intention to extirpate the left external carotid artery, but the division of the vessel must have been very high and could not easily be found, so after about fifteen minutes a temporary ligature was placed about the common carotid and the wound was left open. The right external carotid artery was then extirpated without difficulty, the bifurcation being found in its normal situation. This wound was now closed by suture, with temporary tube drainage. Attention was now directed to the attack upon the tumor itself, and during this part of the operation the left common carotid was drawn upon by a ligature in the hands of an assistant to produce temporary hæmostasis. An incision was made along the superior maxilla above the line of the alveolar process, and upon removing the mucous membrane by blunt dissection it was found that the tumor involved the bone, which was softened and gave the characteristic crackling sound. The growth evidently extended from within the nose to the orbital margin, and as far back as the first molar, while below its limits were marked by the second bicuspid. In order to gain a better access to the growth, Dr. Lilienthal said he adopted a method suggested by Dr. T. Passmore Berens: namely, he incised the upper lip vertically at its central point and continued the incision through the lip to the ala of the nose and along the floor of the nasal cavity. With

the chisel the entire tumor was now removed with ease, and on examining the specimen, every portion of it appeared to have been extirpated with the exception of the inner part, adjacent to the nasal septum. Here some of the soft tissue of the tumor was seen to have been cut cleanly through by the chisel. This was dark and apparently melanotic in appearance, and was easily shelled out with the curette. The entire wound, including the left nostril, was now packed with gauze, and the ligature embracing the common carotid was loosened. This was immediately followed by severe hemorrhage from numerous vessels, so that it was deemed advisable to ligate and divide the carotid. The wound in the left side of the neck was then closed with suture, with temporary tube drainage, and the wound in the lip was sutured.

The patient made an uneventful recovery from the operation, but upon examination, on December 23, it was found that a small, hard fragment of bony tumor was still present adjacent to the nasal bone. This had since disappeared under the regular administration of Coley's mixed toxins of the bacillus erysipelas and prodigiosus.

Pathologically, the growth in this case was pronounced a spindle-celled osteo-sarcoma, especially malignant.

Dr. Lilienthal said he had made use of Coley's fluid for many years, and he believed that as a result he had had fewer recurrences after operation. This was only the second case, however, where he had seen it apparently produce an absolute disappearance of what was undoubtedly a fragment of a malignant growth. In the other case which he had in mind the patient was a man who was operated on about twelve years ago for what was pronounced to be a pigmented giant-celled sarcoma of the rib. A very large section of the pleura was removed, but the extirpation was necessarily incomplete. There was an immediate recurrence in the scar, and it was not until then that the administration of Coley's fluid was begun. Its use was followed by a disappearance of the malignant growth, and the patient still remained well, now twelve years after the operation.

DR. F. S. MANDLEBAUM said that in dealing with sarcoma of the bones, one must make a sharp distinction between the spindle-celled and the giant-celled types. The latter was not a true sarcoma, and the sooner it was taken out of the class of sar-

comata, the better, as it was not a malignant tumor at all. That point was brought out in a discussion on the subject before this society about eight years ago. A case had been presented in which he had made the diagnosis of giant-celled sarcoma of the femur, and on account of the subsequent course of the case, the correctness of that diagnosis was questioned, and at that time he made the statement that a giant-celled sarcoma was not a malignant tumor at all. Since then, several pathologists have made similar statements.

In the second case mentioned by Dr. Lilienthal, the tumor was a giant-celled sarcoma, and the speaker said he was not surprised to learn that the patient was still alive, in spite of the fact that a complete extirpation had been found impossible.

In the case shown by Dr. Lilienthal to-night, the speaker said that to the best of his recollection, the pathological picture was that of a spindle-celled osteo-sarcoma, which was usually of a rather malignant type and offered an unfavorable prognosis.

DR. ARPAD G. GERSTER said the preliminary ligation of arteries in operations on the superior maxilla seemed to have become a fixed procedure under the belief that it added to the safety of the operation. Two or three weeks ago, Dr. Gerster said, he ligated the external carotid before the removal of a tumor in the posterior pharynx which was attached to one of the wings of the pterygoid. Previous to that, he had never resorted to a preliminary ligation of the vessels in the neck in operations of this kind, and in this single instance, forty-eight hours after the operation, the patient had a cerebral embolism and died.

Personally, Dr. Gerster said, he failed to see the benefit of such a preliminary ligation. After the surgeon had made his preparatory incision and divided the bony attachments, and removed the detached jaw, the wound could be plugged and the hemorrhage well controlled, and the internal maxillary artery could be caught and tied. After the extirpation of the growth was completed, we had a visible cavity from which the bleeding could be well controlled. He did not think that a preliminary ligation of the external carotid was necessary, and that it simply added to the dangers of an already serious operation.

DR. WALTON MARTIN said that two weeks ago he saw a case of carcinoma of the upper jaw which necessitated an extensive

resection, but in spite of the fact that no preliminary ligation was done, the hemorrhage was not very alarming. He could recall other cases where he had not tied the vessels in the neck and had never had serious bleeding. If we limited the ligation to one side of the neck, the anastomosis was often so free that it would have little effect upon the hemorrhage. He thought it was better to tie the vessels as they were cut.

DR. L. W. HOTCHKISS said he had seen many of these operations on the upper jaw, and had had considerable personal experience with them. Dr. McBurney and Dr. Hartley and most of the other men with whom he had been associated had never resorted to a preliminary ligation of the external carotid. In the case shown by Dr. Lilienthal the ligation, as he understood it, was done for the purpose of starving the growth, thus aiding in the prevention of a recurrence, rather than to check hemorrhage.

DR. MOSCHCOWITZ said he had operated on the superior maxilla, both with and without a preliminary ligation of the vessels in the neck, and he had come to the conclusion that such a procedure was a snare and a delusion. A year ago last summer he extirpated both superior maxillæ for a malignant growth. He did a preliminary ligation of the external carotid on one side, and intended to do the same on the opposite side. The artery, supposed to be the external carotid, was partially exposed and ligated. The operation was then completed without incident. The patient died three days later, and at the post-mortem it was found that on one side the common carotid had been tied, probably giving rise to a degenerative process in the brain.

Dr. Moschcowitz said he mentioned this instance, as he understood that Dr. Lilienthal had tied the common carotid in his case.

DR. F. KAMMERER did not think that preliminary ligation of the external carotid on the affected side controlled hemorrhage during resection of the superior maxilla; the procedure was, furthermore, unnecessary where so large an opening was made to expose the seat of the disease, and where the individual vessels could be so easily caught and ligated. However, he considered ligation of both external carotids a valuable preliminary procedure in extended operations on the nasal and oral cavities; as, for instance, in Kocher's temporary resection of

both superior maxillæ, where the only incision made was a vertical one through the upper lip, and the bleeding was not as easily controlled as in the more open operation of resection of the superior maxilla.

DR. CHAS. L. GIBSON said that some years ago, preliminary to attacking a tumor in the nasopharynx, he extirpated the external carotid on one side and tied it on the other. In spite of these precautions, he had a very alarming hemorrhage during the course of the operation.

DR. LILIENTHAL, in closing, said the operative procedure which he had followed in this case, which he believed to be a good one and which he had successfully carried out in other cases, was to extirpate both external carotids, as suggested by Dawbarn. The artery on the right side was extirpated without any trouble, but the left external carotid was situated so high up that it could not be reached. He thereupon ligated the left common carotid, which he had done in former cases without injurious results. In one case, a patient with a pulsating exophthalmus, supposed to be due to an aneurism of the cavernous sinus, he had ligated both common carotids within ten days of each other: that patient survived for several years, and finally died from hemorrhage after another operation upon the neck for the ligation of anastomatic arteries.

ON THE FORMATION OF BONE IN THE HUMAN PENIS.

DR. ARPAD G. GERSTER read a paper with the above title, for which see page 896.

DR. MANDLEBAUM said the formation of bone in fibrous connective tissue was not purely a pathological process, but occurred physiologically as well, on the roof and sides of the skull. Most of the bones of the face were also formed in this manner. When bone formation took place in fibrous connective tissue, the first step in the process was the change or transformation of the normal connective-tissue cells into osteoblasts; this was a process of metaplasia, in which the connective-tissue cells lost their identity and were practically transformed into new cells. The intracellular substance became transformed into osteoid tissue. The final stage was the deposit of lime salts, and we then had true bone.

This new bone formation in various tissues of the body was

not very rare. Bone had been found in various organs and tissues, including the dura and pia mater, in the scleroid and choroid, in the tonsils, in the thyroid, the lung and pleura and other serous membranes. It had also been found in the endocardium, the stomach, the liver, the kidneys, the adrenals, the ovaries, the Fallopian tubes, the urinary bladder, the testicles, the arteries, muscles, lymph nodes, and the skin. In the case reported by Dr. Gerster the formation of bone in an organ like the penis interfered with the function of that organ: in other locations its presence was merely an incident. Personally, Dr. Mandlebaum said, he had found abnormal deposits of bone in a number of cases, half a dozen or more, once in the liver and a few months ago in a small fibroma which was removed from a woman's thigh.

BOOK REVIEWS.

SURGICAL OPERATIONS, A Hand-Book for Students and Practitioners. By PROF. FRIEDRICH PELS-LEUSDEN, of Berlin. Authorized English translation by FAXTON E. GARDNER, M.D., of New York. Rebman Company, 1912.

PROFESSOR PELS-LEUSDEN is well known as chief surgeon in the University Surgical Clinic at the Royal Charity Hospital in Berlin, where his teaching experience should well qualify him to prepare a book on surgical operations which might be of service to students and general practitioners. This book is virtually a text-book on operative surgery, as it embraces all of the ordinary operations; and might just as well have been addressed to practitioners of surgery. It is a well rounded book, and one to which the surgeon may turn expecting to find a description of any of the usual operations.

The author departs often from the conventional in the description of his own peculiar methods. This is to be expected in a surgeon of personality. It is to be regretted that more of the text-books for practical use do not oftener reflect the peculiarities of the author. Most of our surgical books are written apparently with pains to conform to what is most generally accepted.

This book contains some six hundred and sixty-eight illustrations—most of them poor, from the artistic standpoint. Although inartistic, it may be said of them that they show what the author wishes to show. There has been such a surfeit of beautiful pictures in the last twenty years that it seems rather novel again to encounter the class of illustrations which characterized the preaseptic period. The diagrammatic method is much employed in this book—and very effectively. The illustrations are simply numbered, and lack the descriptive legends which have proved so useful in modern books. It is not at all satisfactory to have to search the text for a description of an illus-

tration which might as well have been placed in the immediate company of the picture.

Contrary to its title, the book deals also with after-treatment in some cases. The translation has been well done, but in many instances idiomatic German is responsible for leaving the reader somewhat confused as to the meaning intended.

Intubation anæsthesia is not described, nor is the American positive pressure method in thoracic surgery. The references to the literature are almost wholly German. But eight American surgeons are mentioned. The author practises in his clinic anterior gastro-enterostomy in preference to the posterior operation. He states that the anterior operation is the routine technic in many large clinics and hospitals, year in and year out, and is practised with the best success.

We search in vain for the modern operations for aneurism, for transplantation of joints, and for joint resections. The description of operation for fracture of the patella is inadequate. The operations for cleft-palate and harelip are admirably described.

It cannot be said that we have too many books on surgical operations. Each is excellent in some respect. This book is by no means superfluous. It crystallizes the methods of an experienced surgeon. We cannot have too many such books if the surgeons can afford to write them.

J. P. WARBASSE.

DIE CHIRURGIE DER BLUTGEFÄSSE UND DES HERZENS. By ERNST JEGER, M.D. 328 pages, 231 illustrations. Berlin: August Hirschwald, 1913.

By reason of the fact that progress in the surgery of the blood vessels has been dependent for the most part upon comparatively recent experimental work and has consisted in the development of a highly specialized technic, Jeger's work is in the main a discussion of the technical aspects of this branch of surgery as applied to laboratory animals and the significance in experimental medicine of the procedures dependent upon this technic. The indications, applications and results of vascular surgery in man are given secondary but sufficient consideration;

while historic features are properly touched upon. A chapter is devoted to the experimental surgery of the heart.

The subject in general is presented in a thorough and logical manner. The book is well arranged and profusely illustrated so that the interpretation of the text is made easy. Practically all methods of technic having to do with vascular surgery are exhaustively described; the relative merits of the various procedures are thoroughly discussed and very fair and sane conclusions are drawn. The work evidences a painstaking study of contributions on the subject. Moreover, the author has evidently devoted much thought and labor to the development of technical details. This is evidenced, in part, by innumerable ingenious devices of his own. The work, therefore, while a fairly thorough compilation of contributions, is far more than a review, since it represents the ideas of a man who has tested and practised the various procedures.

The work is dedicated to Carrel, and to his efforts Jeger rightly attributes the recent developments in vascular surgery.

The book begins with a review of the general principles of vascular, including endothoracic, surgery. Jeger emphasizes the fact that this branch of surgery demands not only unusual dexterity but also the extreme of asepsis, for which all outward conditions must be perfect. This phase, as applied to laboratory work, is fully elaborated.

The technic of vascular surgery is exhaustively described. The significance of blood-vessel surgery in experimental medicine is gone into extensively, and it is made apparent that a fertile field has been opened for the study of the physiological and surgical problems. The whole question of transplantation is considered and the various phases of auto-, homo- and hetero-transplantations discussed.

The work unquestionably will prove of much value to research workers by reason of the technical instruction and suggestive ideas which it offers and for its bibliography. For the general surgeon it will prove an interesting and instructive résumé of vascular surgery; it also presents much valuable gen-

eral surgical information, but the fact that the new phases of vessel surgery which have a proved practical application in man are at present very limited and have for the most part appeared in recent and generally accessible American periodicals, minimizes the practical value of the book for the American surgeon.

EUGENE H. POOL.

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A Monthly Review of Surgical Science and Practice.

Edited by LEWIS STEPHEN PILCHER, M.D., LL.D., of New York.

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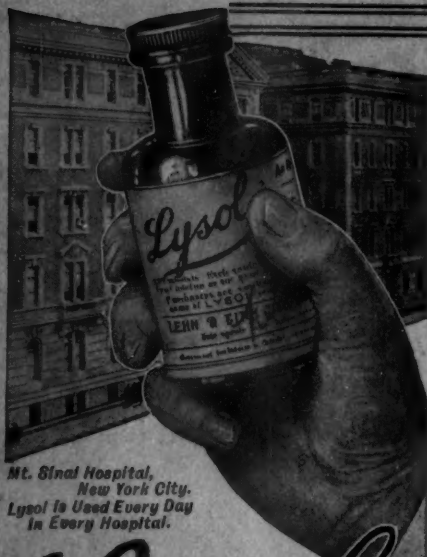
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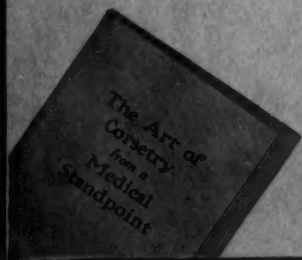


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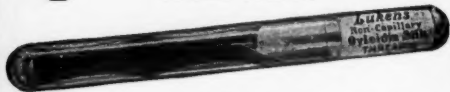
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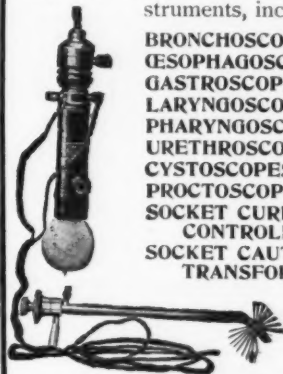
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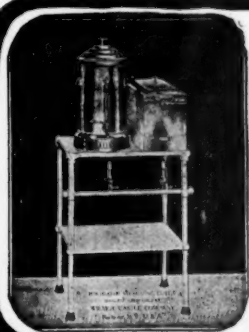
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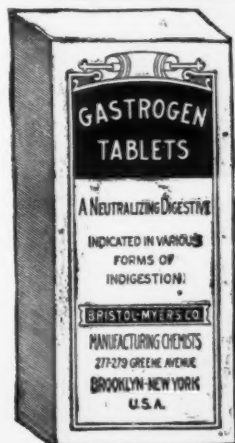
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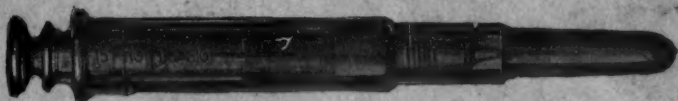
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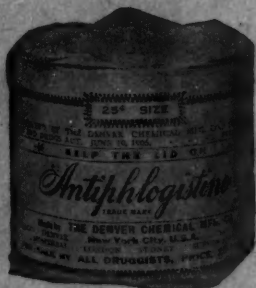
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